No. 2015-1574

UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

IMMERSION CORPORATION,

Plaintiff-Appellant,

v.

HTC CORPORATION and HTC AMERICA, INC.

Defendants-Appellees.

Appeal from the United States District Court for the District of Delaware
in case no. 1:12-cv-00259-TBD, Hon. Richard G. Andrews & Hon. Timothy B. Dyk

BRIEF FOR PLAINTIFF-APPELLANT IMMERSION CORPORATION

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CERTIFICATE OF INTEREST

Counsel for plaintiff-appellant Immersion Corporation certifies the following:

1. The full name of every party or amicus represented by me is:

Immersion Corporation

2. The name of the real party in interest (if the party named in the caption is not the real party in interest) represented by me is:

N/A

3. All parent corporations and any publicly held companies that own 10% or more of the stock of the party or amicus curiae represented by me are:

N/A

4. The names of all law firms and the partners or associates that appeared for the party or amicus now represented by me in the trial court or are expected to appear in this court are:

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Dated: August 5, 2015

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No other appeal in or from the same civil action in the district court was previously before this or any other appellate court. Counsel for plaintiff-appellant knows of no other case pending in this or any other court that will directly affect or be affected by this Court's decision in this appeal.

JURISDICTIONAL STATEMENT

The district court had jurisdiction under 28 U.S.C. §§ 1331 and 1338. The district court entered final judgment in favor of defendants HTC Corporation and HTC America, Inc. (collectively "HTC"), on March 31, 2015. Plaintiff-appellant Immersion Corporation ("Immersion") timely appealed on April 20, 2015. This Court has jurisdiction under 28 U.S.C. § 1295(a)(1).

STATEMENT OF THE ISSUES

1. Whether, consistent with more than 150 years of precedent and the Patent and Trademark Office's longstanding view, a continuation application is entitled to the priority date of its parent patent under 35 U.S.C. § 120 when the application is filed no later than the same day the parent patent issues.

2. Whether a reasonable jury could conclude that HTC failed to prove by clear and convincing evidence that Immersion's application was not filed "before the patenting" of its parent patent under Section 120 when (1) Immersion's application was filed the same day that the parent patent issued, (2) the PTO examined whether the copendency requirement of Section 120 was met and concluded that it was, and (3) HTC offered no evidence that Immersion filed its application after the parent patent issued.

INTRODUCTION

Under Section 120 of the Patent Act, a continuation application receives the filing date of an earlier application when, among other things, it is copending with that application—*i.e.*, when "filed before the patenting or abandonment of or termination of proceedings on the first application." 35 U.S.C. § 120. For more than 150 years, the law has been that a continuation application satisfies that copendency requirement when filed the same day the parent patent issues.

The district court in this case jettisoned that long-settled rule. The court instead fashioned its own novel requirement that patentees prove the precise time of day the PTO filed their patent applications in order to determine whether that event occurred "before the patenting." In doing so, the court rejected the PTO's 54-year-old rule imposing no such requirement and cast doubt on the validity of the countless patents issued in reliance on that rule. The court also turned the presumption of patent validity on its head by requiring a patentee opposing summary judgment to establish the validity of its own patents.

Both the district court's statutory interpretation and its application of summary judgment principles were deeply flawed. First, the district court misinterpreted Section 120. Since 1961, the PTO's Manual of Patent Examining Procedure ("MPEP") has expressly told inventors that a continuation application will be deemed copending with its parent application if the continuation

application is filed on the same day that the parent patent issues. Because Section 120 is silent as to precisely when the "filing" and "the patenting" happen, and because both are purely administrative occurrences, a determination by the PTO is the *only* way to sequence the two events when they both occur on the same day. The PTO has therefore sensibly adopted a rule that, when a continuation application is filed the same day its parent application issues, the patenting is deemed to occur after the filing, such that the two applications are copending under Section 120.

The district court here, however, rejected that longstanding rule. It instead held that when both events occur on the same day, the patentee must prove what time of day the application was filed and what time of day "the patenting" occurred, so that the two times could then be compared. The court thus erroneously required Immersion to prove what the PTO had already determined: that Immersion's patents issued from validly filed continuation applications.

Second, even if the district court's novel reading of Section 120 were correct, the court committed an independent error when it held that patentees cannot survive summary judgment unless *they* produce evidence of the time of day that their continuation applications were filed. According to the district court, because Immersion did not produce this evidence, Immersion had not met its supposed "burden" to establish that its applications were valid continuation

applications under Section 120. The court thus concluded that Immersion's patents were not entitled to the benefit of an earlier priority date, and it granted summary judgment that Immersion's patents are invalid as anticipated.

The district court's ruling turns the statutory presumption of validity on its head and simultaneously disregards black-letter summary judgment principles. The party challenging the validity of a patent, here HTC, has the burden of proving by clear and convincing evidence every fact requisite to an invalidity determination. If any party should have been required to prove the times of "filing" and "patenting," it should have been HTC—the party challenging validity and moving for summary judgment. Absent such evidence, the presumption of validity holds, and the tie goes to Immersion. This principle is especially pertinent here because the PTO's issuance of Immersion's patents necessarily embodied the PTO's administrative determination that Immersion had satisfied the copendency requirement. HTC bore the burden of demonstrating factually—and by clear and convincing evidence—that this PTO determination was erroneous, but it made no attempt to do so.

For all of these reasons, summary judgment of invalidity should be set aside.

STATEMENT OF THE CASE

A. Legal Framework

A "continuation" application is one that is based on the disclosure in an earlier patent application and that receives the benefit of the filing date of that earlier application as long as certain requirements are satisfied. *See Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1326 (Fed. Cir. 2008); *Transco Prods. Inc. v. Performance Contracting, Inc.*, 38 F.3d 551, 555 (Fed. Cir. 1994). Such an earlier filing date can make the difference between validity and invalidity because potentially invalidating prior art may have emerged between the earlier date and the date of the continuation application.

An applicant's right to file a continuation application on the same day that proceedings on the parent application end has been recognized since 1863. That year, the Supreme Court held that when a party "withdraw[s] his application for a patent" and subsequently "file[s] a new petition" "*on the same day*," "the two petitions are to be considered as parts of the same transaction, and both as constituting one continuous application, within the meaning of the law." *Godfrey v. Eames*, 68 U.S. 317, 324–26 (1863). In the subsequent decades, during which continuation application doctrine was a matter of Patent Office practice and common-law decisionmaking, both the Office and courts consistently followed *Godfrey*. *See Transco*, 38 F.3d at 556–57. They thus treated two applications as

part of the same transaction with a common filing date when withdrawal of the first application and filing of the second application happened no later than on the same day. *See, e.g.*, *Smith v. Goodyear Dental Vulcanite Co.*, 93 U.S. 486, 500–01 (1876); *Clark Blade & Razor Co. v. Gillette Safety Razor Co.*, 194 F. 421, 422 (3d Cir. 1912), *aff'g* 187 F. 149, 154–55 (C.C.D.N.J. 1911); *Badische Anilin & Soda Fabrik v. A. Klipstein & Co.*, 125 F. 543, 554–55 (C.C.S.D.N.Y. 1903); *see also* Lincoln B. Smith, *Continuing Applications*, 10 J. Pat. Off. Soc'y 105, 107 (1927) (listing cases following *Godfrey* and explaining that the Supreme Court "has never disavowed, limited or modified the opinion in *Godfrey*").

In the 1952 Patent Act, Congress codified that law and practice in Section 120. *See Transco*, 38 F.3d at 556–57 (explaining that "section 120 merely codified the procedural rights of an applicant with respect to this practice" and that the "legislative history of section 120 does not indicate any congressional intent to alter the Supreme Court's interpretation of continuing application practice" (citing *Godfrey*, 68 U.S. at 325–26)); *see also In re Henriksen*, 399 F.2d 253, 258–60 (C.C.P.A. 1968) (same).

Section 120 provides that an application for an invention disclosed in a previously filed patent application "shall have the same effect, as to such invention, as though filed on the date of the prior application," if certain criteria are met. 35 U.S.C. § 120. Specifically, an application qualifies as a continuation

application if it (1) "names an inventor or joint inventor in the previously filed application," (2) is "filed before the patenting or abandonment of or termination of proceedings on the first application," and (3) "contains or is amended to contain a specific reference to the earlier filed application." *Id*. The second requirement—known as the "copendency" requirement—is at issue in this appeal.

Pursuant to its statutory authority, the PTO promulgated a regulation, 37 C.F.R. § 1.78, to govern procedures for applications that claim the benefit of an earlier filing date. Under that regulation, an application can "claim the benefit of one or more prior-filed *copending*" applications if it, among other things, "name[s] the inventor or a joint inventor named in the later-filed application." 37 C.F.R. § 1.78(d)(1) (emphasis added); *see Encyclopaedia Britannica, Inc. v. Apline Elecs. of Am., Inc.*, 609 F.3d 1345, 1350 (Fed. Cir. 2010) (explaining that a continuation application satisfies Section 120 when "co-pending with the earlier application").

Since 1961, the PTO's MPEP has expressly instructed inventors that later-filed applications will be copending with prior applications if filed on the same date the parent patent issues. *See* MPEP § 211.01(b) (9th ed. 2014); *see also* MPEP § 201.11 (3d ed. 1961). As the current version of the MPEP explains, "[i]f the prior application issues as a patent, it is sufficient for the later-filed application to be copending with it if the later-filed application is filed *on the same date*, or

before the date that the patent issues on the prior application." MPEP § 211.01(b) (emphasis added).

This administrative rule is particularly important because nothing in the Patent Act or PTO rules specifies a time of day that a patent issues. The PTO identifies only a *date* that patents are issued, not a *time* of day. Thus, when a continuation application is filed the same day that the parent patent issues, a rule of decision is necessary to specify which of the two events will be deemed to have occurred first. The MPEP's rule performs that role by providing that a continuation application will be deemed filed before issuance of the parent patent so long as it is filed by the same day that the parent patent issues. Inventors have relied on the MPEP's rule for more than 50 years, and countless continuation applications have been granted in reliance on it. *See Patlex Corp. v. Mossinghoff*, 758 F.2d 594, 606 (Fed. Cir. 1985) ("The PTO operates in accordance with detailed rules and regulations, including those set out in the Manual of Patent Examining Procedure (MPEP) which is made available to the public and which has been held to describe procedures on which the public can rely.").

B. Immersion's '720, '181, and '105 Patents

Beginning in the late 1990s, the PTO granted Immersion multiple patents for inventions in the field of haptic feedback technology. Haptic feedback technology enhances consumers' experience with electronic devices by allowing users to

receive information through touch or tactile sensations. A35 (col.1:43–45, col.2:48–50). For example, the short vibration that users feel when they touch the keypad on a smartphone or tablet is a form of haptic feedback. *See* A35.

In 2011, the PTO granted Immersion the three patents at issue in this appeal: the ’720 patent, the ’181 patent, and the ’105 patent. A23; A46; A67. As stated on the first page of each of the three patents, each application was filed, and accepted by the PTO, as a continuation application in a priority chain tracing at least as far back as a January 19, 2000 effective filing date. A23; A46; A67. The steps in the chain are as follows.

First, the ’720, ’181, and ’105 patents were based on chains of continuity tracing back to the August 6, 2002 filing date of Immersion’s U.S. Patent No. 7,148,875 (“’875 patent”):

- The ’720 patent issued from a continuation of application No. 11/805,609, which was filed on May 23, 2007. That application was itself a continuation of the August 6, 2002 application that issued as the ’875 patent. A67.

- The ’181 and ’105 patents issued from continuations of an application filed on April 17, 2006, which issued as Patent No. 7,592,999. That application was itself a continuation of the August 6, 2002 application that issued as the ’875 patent. A23; A46.

Second, the ’875 patent was filed as a continuation application of a January 19, 2000 application that issued as U.S. Patent No. 6,429,846 (“’846 patent”).

A23; A46; A67; *see also* A136. Thus, through the ’875 patent, the ’720, ’181, and ’105 patents reflect an effective filing date of no later than January 19, 2000.

At issue in this appeal is whether there was a break in the chain of continuity on August 6, 2002. Immersion filed the application for the ’875 patent on that date by depositing it with the United States Postal Service for Express Mail delivery to the PTO. A498; *see* 37 C.F.R. § 1.10(a)(1) (providing that applications delivered by Express Mail are “considered filed with the USPTO on the date of deposit with the” Postal Service). Immersion’s ’846 patent also issued on August 6, 2002. A136.

Because the application for the ’875 patent was filed the same day that the ’846 patent issued, the PTO considered the ’875 application to have been filed before the patenting of the ’846 patent. The ’720, ’181, and ’105 patents that the PTO issued to Immersion thus state that the ’875 patent is a continuation of the ’846 patent. A23; A46; A67. That administrative determination means that all these patents are entitled to a priority date no later than January 19, 2000. A23; A46; A67.

C. Proceedings Below

1. Immersion’s infringement allegations and HTC’s affirmative defense of invalidity

Immersion filed this suit against HTC, alleging direct and indirect infringement of the ’720, ’181, and ’105 patents, among others. A126–A130.

HTC answered with several affirmative defenses to infringement. In its twelfth affirmative defense, HTC alleged that "the '720, '181, and '105 patents [we]re invalid and/or unenforceable for failure to comply with 35 U.S.C. § 120." A375. HTC contended that "[t]he '875 patent . . . was not filed 'before' the '846 patent was patented" because both events happened on the same day and that HTC was entitled to "discovery on additional prior art due to this change in the priority date." A376. HTC made this allegation of invalidity solely as an affirmative defense to liability, and not as an invalidity counterclaim. A375–A376.

2. HTC's motion for summary judgment

HTC moved for summary judgment on its affirmative defense of invalidity of the '720, '181, and '105 patents. A381–A401; A396–A399. To make out a *prima facie* case of invalidity, HTC pointed to a foreign counterpart patent application for the '846 patent that was published in July 2001 and that shared the same specification as the '720, '181, and '105 patents. A399. HTC argued that the foreign counterpart application was prior art that anticipated Immersion's patents because it purportedly described the invention in a printed publication more than one year prior to the date of the applications for the '720, '181, and '105 patents. A399; *see* 35 U.S.C. § 102(b) (pre-AIA).

HTC also acknowledged that Immersion's patents issued from a chain of continuation applications that claim a priority date of no later than January 19,

2000. A396. HTC nonetheless argued that the correct priority date was August 6, 2002 because the ’875 continuation application purportedly “broke” the chain of continuity, as it was filed on August 6, 2002, the same day the parent ’846 patent issued. A396–A399. According to HTC, that meant that the ’875 continuation application was not filed “before” the patenting of the ’846 patent, as Section 120 requires. A396–A399.

In rebuttal, Immersion argued that the July 2001 foreign counterpart applications are not prior art because Immersion’s patents are entitled to the January 2000 priority date. A552–A560. Immersion explained that neither the filing of the application nor the issuance of the patent is associated with any particular time of day and that “patenting” is not even defined in the statute or case law. A554–A557. Thus, Immersion stated, it is within the PTO’s discretion to determine as a matter of administrative procedure whether the application and the patenting are copending. A554–A560. Here, each of the patents granted by the PTO reflects on its face that it was based on valid continuation applications claiming priority back to at least January 2000. A23; A46; A67.

3. The district court’s ruling on summary judgment

The district court granted summary judgment for HTC. A4–A8. First, the district court gave no weight to the PTO’s longstanding construction of Section 120 or the agency’s implementing regulations. A7. In the court’s view, no

deference was owed to the PTO's rule permitting same-day continuation filings because Section 120 is neither "silent" nor "ambiguous" as to when such applications must be filed. A7. The statute, the district court concluded, "expressly states that the application must be filed 'before' the parent application issues," and the PTO's rule was therefore inconsistent with the statutory text. A7.

Next, the district court turned to the timing issue. As an initial matter, the court rejected HTC's argument "that a patent automatically issues at 12:00:01 a.m. on the issue day," which would make it impossible for an application be filed on the day the patent issued. A7. Yet the court nevertheless granted summary judgment to HTC. A8. According to the district court, HTC was entitled to summary judgment because Immersion had "presented no evidence of *when* on August 6, 2002 the applications were filed"—even though HTC had presented no such evidence either. A7 (emphasis added).

4. Immersion's motion for reargument

In a motion for reargument, Immersion pointed out that in ruling for HTC, the district court incorrectly shifted to Immersion the burden of proving validity. A2005; *see Microsoft Corp. v. i4i Ltd. P'ship*, 131 S. Ct. 2238, 2242 (2011).

The district court denied Immersion's motion. A19–A21. The court reiterated its view that Immersion "did not meet its burden of coming forward with evidence" to prove that "the patent is entitled to an earlier priority date." A20.

According to the district court, "[w]hen there is no evidence on either side of an issue, the party with the burden of going forward loses." A20. "Here, there is evidence that two things occurred on August 6, 2002. Plaintiff offered no evidence of which occurred first, and therefore did not meet its burden of production." A20.

5. Partial settlement and final judgment

After entry of summary judgment concerning the validity of the '720, '181, and '105 patents, the parties agreed to settle all other issues in the case. The district court therefore entered final judgment providing that (1) HTC does not infringe the '720, '181, and '105 patents solely because the court had determined that HTC prevailed on its affirmative defense of invalidity; (2) Immersion's other claims of infringement are dismissed with prejudice; and (3) Immersion reserves its right to appeal the summary judgment order invalidating the '720, '181, and '105 patents. A22.[1]

SUMMARY OF ARGUMENT

The district court's judgment should be reversed for two independent reasons: the court misread Section 120 of the Patent Act, and it misapplied the summary judgment standard.

[1] District Judge Richard G. Andrews presided when summary judgment was entered and Immersion's motion for reargument was denied. Thereafter, Circuit Judge Dyk was appointed to serve by designation. Judge Dyk presided when the final judgment issued.

I. The district court's decision should be reversed because, under the proper reading of Section 120, Immersion's patents are entitled to a priority date of January 19, 2000, and are therefore not anticipated.

a. The text, structure, and history of Section 120 leave no doubt that a continuation application is "filed before the patenting" of a parent application when, as here, it is filed no later than the same day the parent patent issues. First, because the Patent Act is silent as to the time of day a patent issues or an application is filed, Section 120 authorizes the PTO to determine the sequence of events on the day a patent issues. As such, under the text and structure of Section 120, a continuation application filed the same day its parent patent issues is "filed before the patenting" when the PTO sequences the events in that manner and correspondingly records that formal determination on a duly issued patent.

Second, the history of Section 120's enactment reveals that Congress intended to codify existing law and practices related to continuation applications. Most critically, Congress intended Section 120 to embody the Supreme Court's long-established rule permitting same-day filings for continuation applications. Indeed, nothing in Section 120's legislative history indicates any intent to abrogate *Godfrey v. Eames* or the decades of PTO practice preceding the 1952 Patent Act.

Third, not only did Congress codify *Godfrey*'s same-day filing rule in Section 120, but it has also since ratified the PTO and the judiciary's consistent

implementation of that doctrine. Since at least 1961, the PTO has permitted generations of inventors to file continuation applications the same day their parent patents issue—and the courts have rightly affirmed that sensible approach. During that same time, Congress revisited Section 120 multiple times but never altered the statute's copendency requirement. By reenacting the statute in its entirety and amending unrelated clauses, Congress indicated its approval of the PTO practice on which inventors have relied in filing their continuation applications on the same day their parent patents issued.

b. Even if the statute is ambiguous, this Court should defer to the PTO's sensible, longstanding implementation of Section 120. First, the PTO's rules and regulations on continuation applications warrant *Chevron* deference, because they rest on a reasonable reading of a statute governing "the conduct of proceedings in the [PTO]," *see* 35 U.S.C. § 2(b)(2)(A). Second, the relevant MPEP rules are entitled to *Auer* deference, because they reflect the agency's fair and considered interpretation of its own regulations—specifically, the term "copending" in 37 C.F.R. § 1.78. Third, at a minimum, the PTO's practices merit deference under *Skidmore* given the agency's unbroken, 54-year tradition of interpreting Section 120 as it did here in issuing Immersion's patents. Finally, because the inventing community has, for generations, ordered its affairs around the PTO's continuation-

application rules, this Court should honor such deeply rooted reliance interests by deferring to the PTO's longstanding construction of Section 120.

II. The district court's decision should also be reversed because its misapplication of the summary judgment standard impermissibly required Immersion (the patentee) to prove the validity of its patents—rather than requiring HTC (the challenger) to prove *in*validity by clear and convincing evidence.

a. Congress has mandated that all patents are presumed valid and that the burden of proving invalidity rests—at all stages—on the challenger. These patent-specific principles apply with full force at summary judgment. Thus, Immersion's patents could not be invalidated by prior art at summary judgment unless HTC proved by clear and convincing evidence all issues necessary to show that the alleged prior art anticipated Immersion's patents. In other words, HTC's motion could succeed only if any reasonable jury would find that HTC had proven all issues essential to invalidity by clear and convincing evidence.

b. But here, HTC did not carry its burden. Even if HTC made out a *prima facie* case of invalidity, Immersion discharged its burden of production—and thereby defeated summary judgment—by submitting official public records that proved its patents were entitled to an effective priority date earlier than HTC's alleged prior art. Specifically, because the PTO rejects all continuation applications that fail Section 120's copendency requirement, and because the PTO

granted Immersion's patents as valid continuation applications, the patents themselves constituted sufficient rebuttal evidence, and thus foreclosed summary judgment.

c. By contrast, however, HTC provided no evidence of any kind—much less clear and convincing evidence—to support its assertion that Immersion's continuation applications were *not* filed "before the patenting." Without such evidence, however, HTC could not carry its heavy burden of proving invalidity. It was therefore not entitled to summary judgment.

STANDARD OF REVIEW

This Court reviews a grant of summary judgment under regional-circuit law—here, the Third Circuit. *Frolow v. Wilson Sporting Goods Co.*, 710 F.3d 1303, 1308 (Fed. Cir. 2013). The Third Circuit reviews a grant of summary judgment *de novo*. *Id.* Summary judgment is appropriate only "if the movant 'shows that there is no genuine dispute as to any material fact and the movant is entitled to judgment as a matter of law.'" *Id.* (quoting Fed. R. Civ. P. 56(a)). Under that standard, summary judgment must not be granted unless, after viewing all evidence "in the light most favorable to the party opposing the motion, no jury could decide in that party's favor." *Tigg Corp. v. Dow Corning Corp.*, 822 F.2d 358, 361 (3rd Cir. 1987); *see also Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242,

255 (1986) ("[E]vidence of the non-movant is to be believed, and all justifiable inferences are to be drawn in his favor.").

Adherence to this standard is particularly important in patent disputes. Because all patents are "presumed valid," 35 U.S.C. § 282(a), the burden to prove invalidity by clear and convincing evidence always rests on the challenger—even when, as here, invalidity is asserted only as an affirmative defense to infringement, *see Microsoft*, 131 S. Ct. at 2242–43. Hence, a patent challenger like HTC is not entitled to summary judgment unless it carries its unchanging burden to prove invalidity by clear and convincing evidence. *See Anderson*, 477 U.S. at 255 ("[T]he clear-and-convincing standard of proof should be taken into account [at summary judgment].").

ARGUMENT

I. IMMERSION'S '720, '181, AND '105 PATENTS ARE NOT ANTICIPATED BECAUSE, UNDER THE CORRECT READING OF 35 U.S.C. § 120, THOSE PATENTS ARE ENTITLED TO THE BENEFIT OF THE '846 PATENT'S FILING DATE

Under the correct interpretation of Section 120, Immersion's '875 continuation application was "filed before the patenting" of the '846 patent. 35 U.S.C. § 120. Accordingly, the '720, '181, and '105 patents are entitled to a priority date no later than the filing date of the application that issued as the '846 patent. And because the '846 patent's priority date precedes July 2001, HTC's

alleged prior art therefore could not have anticipated the ’720, ’181, and ’105 patents. Summary judgment should thus be reversed.

A. Under The Correct Interpretation Of Section 120, Immersion Filed Its Application For The ’875 Patent “Before The Patenting” Of The ’846 Parent Patent

1. The plain text of Section 120 supports this reading

Section 120 provides that a patent application must be “filed before the patenting or abandonment of or termination of proceedings on the first application.” 35 U.S.C. § 120. The district court treated the issue in this case as exclusively concerning the meaning of the word “before” in Section 120. A7 & n.1. But there is no disagreement over the meaning of “before.” “Before” means “preceding in time, or earlier than.” *Black’s Law Dictionary* 154–55 (6th ed. 1990).

Rather, the pertinent question is *what* must come “before” *what*. Section 120 provides that a continuation application must be “filed before the patenting” of the first application. 35 U.S.C. § 120. Yet the Patent Act is silent on the question of *when* precisely a patent application can be understood to have been “filed” or *when* precisely “the patenting” takes place. The district court nonetheless apparently believed that there was a specific time of day at which the filing of the continuation application occurs (even where, like here, there was no electronic filing) and another precise time of day at which the patenting of the

parent application occurs, such that the two times could be compared. A7. That is incorrect.

Under the PTO's regulations, an application is deemed filed on the "*date* of deposit" in the mail for transmission to the PTO. 37 C.F.R. §§ 1.6(a)(2), 1.10(a)(1) (emphasis added); *see* 37 C.F.R. §§ 1.6(a)(2), 1.10(a)(1) (2002) (same); *see also* 37 C.F.R. § 1.10(a)(2) ("The date of deposit with USPS is shown by the 'date accepted' on the Priority Mail Express® label or other official USPS notation."). Although the PTO has not literally placed the application into its files when it is merely deposited for mailing by an applicant, it is beyond dispute that the PTO has administrative authority to *deem* an application filed on that day. Indeed, rules providing that filing or service is deemed complete as of the date of deposit into the mail are commonplace. *See, e.g.*, Fed. R. App. P. 25(a)(2)(B)(i) ("A brief or appendix is timely filed . . . if on or before the last day for filing, it is . . . mailed to the clerk by First-Class Mail."); Fed. R. Civ. P. 5(b)(2)(C) ("[S]ervice is complete upon mailing."). The PTO does not set any particular time of day at which the filing is deemed to have occurred.

Similarly, there is no particular point in time at which "the patenting" of the first application takes place. As an initial matter, the phrase, "the patenting" appears nowhere in the Patent Act other than in Section 120. The district court substituted "issuance" for the statutory term, "the patenting." A7; A14. But, even

then, neither the Patent Act nor the PTO specifies the precise time of day or the precise event that causes the patent to issue. *See, e.g.*, 35 U.S.C. §§ 151–154; *see also Exxon Chem. Patents, Inc. v. Lubrizol Corp.*, 935 F.2d 1263, 1269–70 (Fed. Cir. 1991) (Newman, J., concurring in the judgment) (observing that no statute sets a "manner or time" for patent issuance).

Instead, the Act simply prescribes the formal requirements for issuing a patent. Specifically, the PTO is to issue the patent after issuing the written notice of allowance and after the patentee pays the fee. 35 U.S.C. § 151. The patent must be "issued in the name of the United States of America, under the seal of the Patent and Trademark Office, and shall be signed by the Director or have his signature placed thereon and shall be recorded in the Patent and Trademark Office." *Id.* § 153. The Patent Act also identifies the "*date* on which" a patent's term begins—*i.e.*, "the date on which the patent issues." *Id.* § 154(a)(2) (emphasis added). But there is no specific time for the issuance of a patent identified in the Patent Act.

Indeed, neither the filing of an application nor the issuance of a patent is tied to any discrete physical act. Thus, when both occur on the same day, the determination of which of the two comes first cannot be made simply by clicking one stopwatch when the application is "filed" and another at "the patenting," and then comparing the two times. Instead, determining which of these two purely

administrative actions happens "before" the other is itself a purely administrative determination.

To that end, the PTO's procedures provide that if the filing of the continuation application and the patenting of the parent patent occur on the same day, both applications are deemed copending in satisfaction of Section 120's requirements. MPEP § 211.01(b). That is, the PTO has determined that when both administrative events happen on the same day, the filing of the continuation application happens first. Accordingly, a continuation application filed on the same day the parent patent issues is always filed "before the patenting," and is thus entitled to the filing date of the first application under the plain text of Section 120.

Here, the '875 application was filed on the same day that the '846 patent issued. The PTO deemed the '875 application filed on that date, and the PTO issued the '846 patent. According to the PTO's procedures, the '875 application was deemed to have been filed *before* the issuance of the '846 patent. Thus, under the text of Section 120, the '875 application is entitled to the filing date of the '846 application.

The district court's contrary interpretation of Section 120 cannot be correct, as it effectively rewrites the provision. At the outset, the district court correctly rejected HTC's submission "that a patent automatically issues at 12:00:01 a.m. on the issue day," which would mean that all continuation applications had to be filed

the day before patenting. A7. But the court nonetheless interpreted the statute in a way that effectively included the very requirement the court had just rejected. The court read Section 120 as requiring Immersion to prove which of the two administrative actions physically came first on the day of filing—and did not accept the PTO's determination on that precise question. A7. But because the PTO's determination is the *only* evidence of the sequencing of those same-day events, the district court's interpretation effectively requires all continuation applications to be filed the day before issuance of the parent patent. "To this proposal, '[t]he short answer is that Congress did not write the statute that way.'" *Corley v. United States*, 556 U.S. 303, 315 (2009); *see Diamond v. Chakrabarty*, 447 U.S. 303, 308 (1980) ("[C]ourts should not read into the patent laws limitations and conditions which the legislature has not expressed." (internal quotation marks omitted)).

Indeed, as other provisions of the Patent Act make clear, where Congress wants to refer to something occurring on or before a day or date, it does so expressly. *See, e.g.*, 35 U.S.C. § 3(e)(1) ("on the day before"); *id.* § 291(b) ("the date of the issuance"); *id.* § 321(c) ("the date of the grant of the patent"). When, as here, "Congress includes particular language in one section of a statute but omits it in another section of the same Act, it is generally presumed that Congress acts

intentionally and purposely in the disparate inclusion or exclusion." *Russello v. United States*, 464 U.S. 16, 23 (1983).

2. The history of Section 120 shows that the statute permits same-day continuation filings

Congress enacted Section 120 to codify longstanding PTO and common-law practices governing continuation applications—practices that from their inception permitted same-day filings. This history further demonstrates that the district court's interpretation was erroneous.

In all cases, statutory text must be construed in light of its meaning "at the time Congress enacted the statute." *Strategic Hous. Fin. Corp. of Travis Cnty. v. United States*, 608 F.3d 1317, 1323–24 (Fed. Cir. 2010). "'[W]here words are employed in a statute which had at the time a well-known meaning at common law or in the law of this country, they are presumed to have been used in that sense.'" *Robert Bosch, LLC v. Pylon Mfg. Corp.*, 719 F.3d 1305, 1318 (Fed. Cir. 2013) (en banc) (quoting *Standard Oil Co. v. United States*, 221 U.S. 1, 59 (1911)). In such instances, this Court's "inquiry begins and ends with a determination of the historical meaning." *Id.; see also Bruesewitz v. Wyeth LLC*, 562 U.S. 223, 243 (2011) (when a statute incorporates "a term or concept" that has been given a "consistent gloss," such a gloss "represents the public understanding of the term" and courts must "presume Congress intended the term or concept to have that meaning").

Here that principle is especially powerful because the Congress that enacted Section 120 intended "merely [to] codif[y] the procedural rights of an applicant with respect to" pre-1952 "continuing application practice." *Transco*, 38 F.3d at 556. Indeed, the only modification Section 120 made to pre-1952 law and procedure was the "requirement that the first application must be specifically mentioned in the second." *Henriksen*, 399 F.2d at 258 (internal quotation marks omitted). Both the House and Senate committee reports thus explained that, with that one exception, "[t]his section [120] represents present law not expressed in the statute." *See* S. Rep. No. 82-1979 & H.R. Rep. No. 82-1923, at 20 (1952), *both reprinted in* 1952 U.S.C.C.A.N. 2394, 2413; *see also In re Bauman*, 683 F.2d 405, 407–08 & n.7 (C.C.P.A. 1982) (noting that Section 120 made only a "minor" modification to the "continuing application practice in *Godfrey v. Eames*").

Before Section 120, case law permitted inventors to file continuation applications on the same day the parent application was abandoned or patented. Indeed, the first decision to recognize the right to file a continuation application was the Supreme Court's decision in *Godfrey*, in which the patent application "was withdrawn and refiled *on the same day* with an amended specification." 68 U.S. at 324 (emphasis added). Courts and the PTO followed that same rule for decades after *Godfrey*. *See* pp. 6–7, *supra*. According to a principal author of the Patent Act, Congress intended Section 120 to codify continuing application practices

"developed by decisions of the courts beginning with . . . Godfrey v. Eames." *See* P.J. Federico, *Commentary on the New Patent Act*, 35 U.S.C.A. (1954), *reprinted in* 75 J. Pat. & Trademark Off. Soc'y 161, 192 (1993); *see also* 4A-13 *Chisum on Patents* § 13.02[3] (2015) (explaining that Section 120's "copendency" requirement "stems from *Godfrey*").

Congress's intent to continue settled practice is confirmed by its decision to apply the new Section 120 to all applications pending upon its effective date. *See* Pub. L. No. 593, Ch. 950 § 4(a), 66 Stat. 815 (1952). There is no indication that Congress intended to take the dramatic and disruptive step of retroactively depriving applicants with pending applications of earlier priority dates to which they would have been entitled under pre-Section 120 practice. *Accord Transco*, 38 F.3d at 557 ("The legislative history of section 120 does not indicate any congressional intent to alter the Supreme Court's interpretation of continuing application practice.").

Congress's decision to codify settled practice into Section 120 was consistent with its approach throughout the 1952 Patent Act. *See, e.g.*, Federico, 75 J. Pat. & Trademark Off. Soc'y at 170 (noting that codifying "prior case law" was a key objective of the Act); *see also Microsoft*, 131 S. Ct. at 2241, 2246 (holding that Section 282's presumption of patent validity incorporated the preexisting "clear and convincing evidence" standard for proving invalidity);

Graham v. John Deere Co. of Kansas City, 383 U.S. 1, 3–4, 13–15 (1966) ("[T]he 1952 Act was intended to codify judicial precedents embracing the principle long ago announced by this Court in Hotchkiss v. Greenwood, 11 How. 248, 13 L.Ed. 683 (1851)."); *Nat'l Steel Car, Ltd. v. Canadian Pac. Ry., Ltd.*, 357 F.3d 1319, 1326 (Fed. Cir. 2004) (noting that 35 U.S.C. § 272 was intended in part "to codify the Supreme Court's holding in *Brown v. Duchesne*, 60 U.S. (19 How.) 183, 15 L.Ed. 595 (1856)").

3. Congress ratified the PTO's longstanding practice of allowing same-day continuation applications

Not only did Congress enact Section 120 to codify the *Godfrey* doctrine, but in the decades following enactment Congress has ratified the PTO's longstanding practice of permitting same-day filings for continuation applications. Congress's decades-long acquiescence in this practice further confirms the soundness of the PTO's longstanding interpretation of Section 120. *See, e.g.*, *Daewoo Elecs. Co., Ltd. v. Int'l Union of Elec., Elec., Tech., Salaried & Mach. Workers, AFL-CIO*, 6 F.3d 1511, 1522 (Fed. Cir. 1993) (holding that Congress's refusal to "repeal [an] agency's interpretation is persuasive evidence that the interpretation is the one intended by Congress" (internal quotation marks omitted)).

Since at least 1961, the PTO has consistently interpreted the "copendency" requirement to be satisfied so long as the continuation application is filed on the same day that the first patent issues. *See* MPEP § 201.11 (3d ed. 1961) ("[I]t is

sufficient for the second application to be copending with [the first] if the second application is filed on the same day or before the patenting of the first application."); MPEP § 211.01(b) (9th ed. 2014) (same). Indeed, the PTO's practice has been so pervasive and uncontroversial that courts and parties have routinely accepted same-day filings without dispute.[2] And, even when challenged in litigation, courts and other federal agencies have deferred to the PTO's construction of Section 120. *See, e.g.*, *Ultratec, Inc. v. Sorenson Commc'ns, Inc.*, 45 F. Supp. 3d 881, 910 (W.D. Wis. 2014) (upholding continuation application filed same day parent patent issued); *see also MOAEC, Inc. v. MusicIP Corp.*, 568 F. Supp. 2d 978, 982 (W.D. Wis. 2008) (holding that, because the PTO had long permitted same-day filings—and because the "underlying purpose" of Section 120 is to ensure "one continuous application" within the meaning of *Godfrey*—a

[2] *See also, e.g.*, *Henriksen*, 399 F.2d at 254–56 & n.2 (affirming in part *Ex Parte Henriksen*, 154 U.S.P.Q. (BNA) 53 (Oct. 28, 1966) (continuation application filed same day predecessor abandoned), and citing *Case Note*, 36 Geo. Wash. L. Rev. 468, 468 (1967) (providing correct dates)); *Hovlid v. Asari*, 305 F.2d 747, 748–49 (9th Cir. 1962) (continuation-in-part filed same day prior application abandoned); *see also Prism Techs. LLC v. AT & T Mobility, LLC*, No. 8:12CV122, 2013 WL 3930002, at *1 (D. Neb. July 30, 2013) (patentee filed continuation application same day parent patent issued); *Merch. Techs., Inc. v. Telefonix, Inc.*, No. 05-CV-1195-BR, 2007 WL 464710, at *1 (D. Or. Feb. 7, 2007) (continuation application filed "same day" parent patent issued); *A & E Prods. Grp., L.P. v. Mainetti USA Inc.*, No. 01-civ-10820-RPP, 2004 WL 345841, at *1 (S.D.N.Y. Feb. 25, 2004) (continuation application filed "[o]n the issue date of the [parent] patent"); *Clover Club Foods Co. v. Gottschalk*, No. 72-2465-DWW, 1973 WL 19868, at *2 (C.D. Cal. Apr. 27, 1973) (continuation filed same day earlier application abandoned).

continuation is filed "before the patenting" even if "filed on the same date that a patent issues on its parent application"); *In re Certain Video Game Sys. & Wireless Controller & Components Thereof*, 2011 WL 7092316, at *1–7 (U.S. Int'l Trade Comm'n, Dec. 22, 2011) (upholding continuation application filed same day parent patent issued).

But despite this consistent reading of Section 120, Congress has never altered the copendency language in that provision. Instead, Congress reenacted that language in its entirety in 1975 and repeatedly preserved it when making targeted amendments to other terms in Section 120. *See, e.g.*, Pub. L. 94–131 § 9, 89 Stat 685, 691–92 (Nov. 14, 1975); *see also Encyclopaedia Britannica*, 609 F.3d at 1351 (noting that in 1999 Congress amended Section 120 to "'establish a time by which the priority of an earlier filed United States application must be claimed'" (citing Consolidated Appropriations Act, 2000, Pub. L. 106–113, 113 Stat 1501 (Nov. 29, 1999))).[3] Indeed, although "Congress legislates actively with respect to patents" in general, *Kimble v. Marvel Entm't, LLC*, 135 S. Ct. 2401,

[3] *See also, e.g.*, Patent Law Treaties Implementation Act of 2012, Pub. L. 112-211, Title I, § 102(5), Title II, § 202(b)(3), 126 Stat. 1527, 1536 (Dec. 18, 2012) (striking the phrase "including the payment of a surcharge" and inserting "including the requirement for payment of the fee specified in section 41(a)(7)"); Leahy–Smith America Invents Act, Pub. L. 112-29, §§ 3(f), 15(b), 20(j)(1), 125 Stat. 288, 328, 335 (Sept. 16, 2011) (amending joint-inventor proviso and the "best mode" reference); Pub. L. 98-622, 98 Stat. 3383, 3384–85 (Nov. 8, 1984) (amending statute to accommodate joint inventors).

2414 (2015), and Section 120 in particular, it has *never* amended Section 120 to alter the longstanding administrative and judicial interpretations permitting same-day filings.

Congress has therefore "expressly incorporate[d]" the PTO's "longstanding interpretation" of Section 120. *FDIC v. Phila. Gear Corp.*, 476 U.S. 426, 437–38 (1986) (applying this principle to statute governing FDIC); *see also J.E.M. Ag Supply, Inc. v. Pioneer Hi-Bred Int'l, Inc.*, 534 U.S. 124, 144–45 (2001) (concluding that Congress approved the PTO's reading of Section 101 because it had not objected to the agency's position "for at least 16 years"). Indeed, when, as here, courts and agencies have "reached a consensus interpretation" of a statute and Congress amends the statute "without changing the relevant provision," courts must presume Congress "implicitly adopted [that] construction." *See Texas Dep't of Hous. & Cmty. Affairs v. Inclusive Cmtys. Project, Inc.*, 135 S. Ct. 2507, 2520 (2015) (internal quotation marks omitted); *see also Kimble*, 135 S. Ct. 2409–10 (finding "congressional acquiescence" where Congress "has spurned multiple opportunities to reverse" a settled interpretation "for more than half a century"); *Microsoft*, 131 S. Ct. at 2252 (citing congressional inaction in face of longstanding judicial interpretation supporting clear-and-convincing standard of proof as support for conclusion that Section 282 embodies that standard).

Accordingly, Section 120's post-enactment history, just like the decades of administrative and judicial practice that preceded enactment of the provision, confirms that the statute is properly read to permit same-day filing of continuation applications.

B. Even If Section 120 Is Ambiguous, The District Court Should Have Deferred To The PTO's Longstanding Procedural Rule Interpreting The Statute

To the extent Section 120 is ambiguous, the PTO's interpretation is reasonable and entitled to deference. Under PTO regulations, Section 120 authorizes an application to "claim the benefit of one or more prior-filed copending nonprovisional applications." 37 C.F.R. § 1.78(d). And under the MPEP, two applications are "copending" when "the later-filed application is filed on the same date, or before the date that the patent issues on the prior application." MPEP § 211.01(b). Those procedural rules and regulations merit substantial deference under any doctrinal framework.

1. The PTO's interpretation of Section 120 is entitled to controlling deference under **Chevron**

The district court should have deferred under *Chevron* to the PTO's reasonable—indeed best—interpretation of Section 120 as permitting same-day filings. Under *Chevron*, courts defer to an agency's interpretation of a statute when (1) the agency has authority to administer the statute, (2) the statute does not clearly speak to the precise dispute, and (3) the agency's interpretation is

reasonable. *Chevron, U.S.A., Inc. v. Nat. Res. Def. Council, Inc.*, 467 U.S. 837, 841–44 (1984). Here, all requirements for *Chevron* deference are present.

As a threshold matter, the PTO has authority to interpret the procedural requirements of Section 120, because they go to the core of the PTO's administrative responsibilities over the filing of patent applications and the issuance of patents. Congress delegated authority to the PTO to issue rules that "govern the conduct of proceedings in the Office." 35 U.S.C. § 2(b)(2)(A). This grant of "plenary authority over PTO practice" is "the broadest of the [PTO's] rulemaking powers." *Stevens v. Tamai*, 366 F.3d 1325, 1333 (Fed. Cir. 2004) (internal quotation marks omitted); *see Lacavera v. Dudas*, 441 F.3d 1380, 1383 (Fed. Cir. 2006) (applying *Chevron* deference to rule issued pursuant to the PTO's "broad authority to govern the conduct of proceedings before it").

This Court has held that MPEP provisions interpreting procedural statutes warrant *Chevron* deference. *See Cooper Techs. Co. v. Dudas*, 536 F.3d 1330, 1335–37 (Fed. Cir. 2008); *accord Bettcher Indus., Inc. v. Bunzl USA, Inc.*, 661 F.3d 629, 646 (Fed. Cir. 2011) (extending *Chevron* deference to PTO interpretation of statute embodied in MPEP). Indeed, as particularly relevant here, this Court extended *Chevron* deference to an MPEP provision addressing whether continuation applications filed pursuant to Section 120 could be subject to inter

partes re-examination. *See Cooper Techs.*, 536 F.3d at 1341–42 (deferring to the PTO's "permissible" interpretation of Section 120).

To be entitled to such deference, an MPEP provision "must be 'procedural'—i.e., it must 'govern the conduct of proceedings in the Office.'" *Id.* at 1335 (quoting 35 U.S.C. § 2(b)(2)(A)). Conversely, the provision must not be "substantive," meaning that it cannot "effect[] a change in existing law or policy which affect[s] individual rights and obligations." *Id.* at 1336 (internal quotation marks omitted). Instead, the provision must "merely clarif[y] or explain[] existing law or regulations." *Id.* (internal quotation marks omitted).

Both requirements are satisfied here. First, the PTO's interpretation of Section 120's copendency requirement is procedural, as it turns entirely on timing requirements for filing paperwork with the PTO and issuance of PTO administrative determinations. *See Transco*, 38 F.3d at 556 (reaffirming that Section 120 confers "procedural rights"); *cf. Lindh v. Murphy*, 521 U.S. 320, 327 (1997) (observing in the context of habeas proceedings that rules "setting deadlines for filing and disposition" would be "merely procedural in a strict sense"); *Sun Oil Co. v. Wortman*, 486 U.S. 717, 722–29 (1988) (statutes of limitations considered "procedural" for purposes of the Full Faith and Credit Clause). The PTO's determination of which of two purely administrative actions occurring on the same day will be deemed to take place "before" the other is quintessentially procedural.

Second, the PTO's interpretation worked no substantive change in law. *See Cooper Techs.*, 536 F.3d at 1336. To the contrary, as explained, it merely codified the longstanding interpretation of the copendency requirement. A "rule which merely clarifies or explains existing law or regulations is 'interpretive'"—not substantive. *Id.* (internal quotation marks omitted).

The district court, however, refused to afford the PTO *Chevron* deference. Although it did not dispute the agency's authority to administer Section 120, or the statute's procedural nature, the court held that deference was inapplicable because Section 120 was purportedly unambiguous, as the statute "expressly states that the application must be filed 'before' the parent application issues." A7. But that is not what the statute "expressly states." A7. The statute says "before the patenting"—an undefined event that appears nowhere else in the statute—not "before the parent application issues." Even under the district court's phrasing, however, the language still does not answer the relevant question: which of two administrative events occurring on the same day is deemed to occur first, when neither occurs at any particular time of day.

The statute does not expressly address that question, but the PTO has offered an eminently reasonable answer. Because there is no actual time that the filing and the patenting occur, the PTO *had* to pick one or the other to come first, in order to be able to administer the filing deadline in Section 120. The PTO thus adopted a

rule of administrative convenience that embodies the Supreme Court's rule from *Godfrey*. That interpretation is reasonable, and the district court should have given it controlling weight.

2. *The PTO's interpretation of its regulations implementing Section 120 is entitled to controlling deference under* **Auer**

The PTO's interpretation is also entitled to controlling deference under *Auer v. Robbins,* 519 U.S. 452 (1997). Under *Auer*, an agency's interpretation of its own regulation is "controlling unless plainly erroneous or inconsistent." *Id.* at 461 (internal quotation marks omitted); *see Decker v. Nw. Envtl. Def. Ctr.,* 133 S. Ct. 1326, 1337 (2013) ("When an agency interprets its own regulation, the Court, as a general rule, defers to it . . . ."); *O'Bryan v. McDonald*, 771 F.3d 1376, 1379 (Fed. Cir. 2014) (same).

As this Court has explained, the deference afforded under *Auer* "is broader than deference to the agency's construction of a statute, because in the latter case the agency is addressing Congress's intentions, while in the former it is addressing its own." *Cathedral Candle Co. v. ITC,* 400 F.3d 1352, 1363–64 (Fed. Cir. 2005). This rule of "strong deference" applies so long as the interpretation "reflects the agency's fair and considered judgment on the matter"—and "even when the agency's interpretation was announced without resort to formal steps." *Thun v. Shinseki*, 572 F.3d 1366, 1369 (Fed. Cir. 2009) (internal quotation marks omitted);

see Chase Bank USA, N.A. v. McCoy, 562 U.S. 195, 208 (2011) (according *Auer* deference to agency interpretation advanced in legal brief).

Here, MPEP § 211.01 is a reasoned interpretation of the PTO's own regulation: 37 C.F.R. § 1.78. As noted, that regulation requires an application to be "copending" with earlier applications to qualify as a continuation. 37 C.F.R. § 1.78(d). Neither HTC nor the district court has questioned the reasonableness of that regulation as an interpretation of Section 120. Indeed, this Court itself has interpreted Section 120 the same way, *i.e.*, as requiring that a continuation application "be *co-pending* with the earlier application." *Encyclopaedia Britannica*, 609 F.3d at 1350 (emphasis added).

Section 211.01 in the MPEP is in turn an interpretation of what is meant by the procedural concept of "copending," a term not used in the statute and not defined in the regulation. The MPEP states that "it is sufficient for the later-filed application to be copending with [a prior application] if the later-filed application is filed on the same date, or before the date that the patent issues on the prior application." MPEP § 211.01(b). For the reasons given above, that interpretation is reasonable and thus entitled to controlling deference under *Auer*.

3. At a minimum, the PTO's interpretation of Section 120 is entitled to great deference under **Skidmore**

Finally, and at the very least, the PTO's position warrants considerable deference under *Skidmore v. Swift & Co.*, 323 U.S. 134 (1944). *Skidmore* requires

"deference to informal agency interpretations of ambiguous statutory dictates." *Cathedral Candle*, 400 F.3d at 1365–66. Particularly when, as here, the agency's interpretation reflects a careful, consistent, and persuasive reading of the statute, courts should defer to the agency's interpretation under *Skidmore*. *See United States v. Mead Corp.*, 533 U.S. 218, 228 (2001).

The PTO's interpretation "represents an agency-wide position" that "has been adhered to consistently" since its formal adoption in 1961. *See Cathedral Candle*, 400 F.3d at 1367. As noted, the PTO has never wavered in its construction of Section 120. *Compare* MPEP § 201.11 (3d ed. 1961), *with* MPEP § 211.01 (9th ed. 2014). That unbroken, 54-year-old position merits strong deference under *Skidmore*. *See Fed. Express Corp. v. Holowecki*, 552 U.S. 389, 399–401 (2008); *see also Kasten v. Saint-Gobain Performance Plastics Corp.*, 131 S. Ct. 1325, 1335 (2011) (according *Skidmore* deference to agency interpretation announced 50 years previously in an enforcement proceeding and subsequently reaffirmed in briefs, administrative actions, and internal compliance manuals).

4. Regardless of what level of deference applies, reliance interests strongly support the PTO's interpretation

The PTO's longstanding interpretation of Section 120 additionally warrants great deference in light of the justifiable reliance interests that have developed around it. *See, e.g.*, *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 32 (1997) ("[Courts] should be extremely reluctant to upset the basic

assumptions of the PTO without substantial reason for doing so."); *Ariad Pharm., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1347 (Fed. Cir. 2010) (en banc) (stressing the importance of reliance interests in the context of patent law).

As the Supreme Court has cautioned, courts must not interpret federal patent law so as to "disrupt the settled expectations of the inventing community." *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.*, 535 U.S. 722, 739 (2002). "[B]ecause parties are especially likely to rely on" established patent law and procedures "when ordering their affairs," courts must, if at all possible, maintain settled law in the patent context. *Kimble*, 135 S. Ct. at 2410 (reaffirming precedent where "a reasonable possibility" exists "that parties have structured their business transactions in light of" it). To hold otherwise would "risk destroying the legitimate expectations of inventors in their property" and "subvert the various balances the PTO sought to strike when issuing the [affected] patents." *Festo*, 535 at 739 (internal quotation marks omitted).

For decades, inventors have relied on the PTO's time-honored rule permitting same-day filing of continuation applications. "In light of these substantial reliance interests," the PTO's "longstanding administrative construction" of Section 120 "should 'not be disturbed except for cogent reasons.'" *Zenith Radio Corp. v. United States*, 437 U.S. 443, 457–58 (1978) (quoting *McLaren v. Fleischer*, 256 U.S. 477, 481 (1921)). Indeed, to hold otherwise would

"unjust[ly]" deny inventors "the fruits of reliance . . . on a longstanding administrative practice reasonably construing a statute." *Ala. Stock, LLC v. Houghton Mifflin Harcourt Publ'g Co.*, 747 F.3d 673, 685–86 (9th Cir. 2014) ("A longstanding administrative interpretation upon which private actors have relied aids in construction of a statute precisely because private parties have long relied upon it.").

II. SUMMARY JUDGMENT SHOULD ALSO BE SET ASIDE BECAUSE THE DISTRICT COURT INCORRECTLY REQUIRED IMMERSION TO PROVE THE VALIDITY OF ITS PATENTS

The judgment below should also be reversed because the district court misapplied the summary judgment standard and misallocated the burden of proof. The district court held that in every case in which a continuation application was filed on the same day as "the patenting" of its parent, Section 120 requires a factual determination of which event occurred earlier on that day. A7. Assuming *arguendo* that view of the statute were correct, both the presumption of validity and the summary judgment standard required HTC—the party seeking to invalidate Immersion's patents and the party moving for summary judgment—to come forward with clear and convincing evidence that the application was *not* filed "before the patenting." Yet HTC offered no such evidence. The district court therefore erred by granting HTC's motion for summary judgment.

A. The Presumption Of Validity And The Summary Judgment Standard Required HTC To Demonstrate That Any Reasonable Jury Would Find Immersion's Patents Invalid By Clear And Convincing Evidence

HTC was not entitled to summary judgment without demonstrating that any reasonable jury would conclude that HTC had demonstrated by clear and convincing evidence that Immersion's patents were invalid. Because patents are "presumed valid," 35 U.S.C. § 282(a), the patent challenger must "convince the court of invalidity by clear evidence," *Am. Hoist & Derrick Co. v. Sowa & Sons, Inc.*, 725 F.2d 1350, 1360 (Fed. Cir. 1984); *see also Commil USA, LLC v. Cisco Sys., Inc.*, 135 S. Ct. 1920, 1928–29 (2015) (noting that the presumption of validity "is a 'common core of thought and truth' reflected in [the Supreme] Court's precedents for a century") (quoting *Radio Corp. of Am. v. Radio Eng'g Labs, Inc.*, 293 U.S. 1, 8 (1934)).

Moreover, the challenger's burden encompasses not only the ultimate conclusion of invalidity but also each subsidiary fact on which the theory of invalidity is based. *See Mahurkar v. C.R. Bard, Inc.*, 79 F.3d 1572, 1576 (Fed. Cir. 1996) (noting that "the burden of persuasion" extends to "*all issues* relating" to invalidity (emphasis added)). Accordingly, while Immersion need not prove any fact bearing on the validity of its patents, HTC "bears a heavy burden of persuasion" to establish invalidity by clear and convincing evidence, and that burden never shifts to Immersion. *Microsoft*, 131 S. Ct. at 2245; *see also Tech.*

Licensing, 545 F.3d at 1327 (stressing that "the risk of decisional uncertainty stays on" the proponent of invalidity throughout the case).

At summary judgment, these principles must be applied through the standards that inhere in that setting. As the Supreme Court has explained, "the determination of whether a given factual dispute requires submission to a jury must be guided by the substantive evidentiary standards that apply to the case." *Liberty Lobby*, 477 U.S. at 255. When substantive law requires that a proponent of a proposition prove it by clear and convincing evidence, adjudication of a motion for summary judgment must reflect that standard. *Id.* at 252–55. Thus, when an opponent of a proposition to be proved by clear and convincing evidence moves for summary judgment, the question is therefore whether the *proponent* has put forward sufficient evidence from which a reasonable jury *could* find in the proponent's favor by clear and convincing evidence. *See id.* If so, summary judgment must be denied.

But that was not the situation in this case. Here, it was the *proponent* (HTC) of the proposition requiring proof by clear and convincing evidence (invalidity) who moved for summary judgment. *See Nat'l State Bank v. Fed. Reserve Bank*, 979 F.2d 1579, 1582 (3d Cir. 1992) (explaining that "[w]here the party moving for summary judgment . . . bears the burden of proof at trial, the standard is more stringent"). Accordingly, HTC's burden was to establish that any reasonable jury

would be *compelled* by clear and convincing evidence to find that Immersion's patents were invalid. *Cf. Liberty Lobby*, 477 U.S. at 255.

B. Immersion Satisfied Its Burden of Production, And HTC Did Not Carry Its Burden Of Persuasion To Show Invalidity By Clear And Convincing Evidence

HTC, "having the ultimate burden of proving its defense of invalidity based on anticipating prior art," had "the burden of going forward with evidence that there is such anticipating prior art." *Tech. Licensing*, 545 F.3d at 1327. That is, HTC had "the initial procedural burden of going forward to establish a legally sufficient *prima facie* case of invalidity." *Ralston Purina Co. v. Far-Mar-Co, Inc.*, 772 F.2d 1570, 1573 (Fed. Cir. 1985).

Here, HTC argued that an international counterpart application for the '846 patent allegedly anticipated the '720, '181, and '105 patents. A399. HTC showed that the international application was published in July 2001, whereas the filing dates for the '720, '181, and '105 patent applications were in 2006 and 2007. A399 & n.70. HTC thus argued that Immersion's patents are anticipated because Immersion's "invention was . . . described in a printed publication in this or a foreign country . . . , more than one year prior to the date of application for patent in the United States." 35 U.S.C. § 102(b) (pre-AIA).

Given HTC's showing, Immersion then had at most only a burden of production, *i.e.*, "the burden of going forward with evidence . . . that the

[purported] prior art . . . is not prior art because the asserted claim is entitled to the benefit of a filing date prior to the alleged prior art." *Tech. Licensing*, 545 F.3d at 1327. In this case, that means pointing to "evidence and argument" that there is "an ancestor to . . . the patent[s] with a filing date prior to the . . . date [of the purported prior art]." *Id.*

Because this issue arose in the context of HTC's motion for summary judgment, Immersion's proffered evidence must be believed and "all justifiable inferences are to be drawn in [Immersion's] favor." *Liberty Lobby*, 477 U.S. at 255. Moreover, because application of the summary judgment standard "must be guided by the substantive evidentiary standards that apply to the case," *id.*, summary judgment for HTC could be granted "only if, as a matter of law, viewing all the evidence . . . in the light most favorable to [Immersion]," any reasonable jury would be compelled to find by clear and convincing evidence that HTC had established the invalidity of Immersion's patents. *Tigg Corp.*, 822 F.2d at 361; *see Liberty Lobby*, 477 U.S. at 252–55.

Immersion easily satisfied its burden of production. It submitted PTO-examined and -granted patents that on their face show they are valid continuation patents in a priority chain tracing at least as far back as a January 19, 2000 effective filing date. A23; A46; A67. The priority claim of the granted '105 patent provides a representative example:

> Continuation of application No. 11/405,811, filed on Apr. 17, 2006, now Pat. No. 7,592,999, which is a continuation of application No. 10/213,940, filed on Aug. 6, 2002, now Pat. No. 7,148,875, *which is a continuation of application No. 09/487,737, filed on Jan. 19, 2000*, now Pat. No. 6,429,846.

A23 (emphasis added). The '875 patent likewise stated that it was a "[c]ontinuation of application No. 09/487,737, filed on Jan. 19, 2000, now Pat. No. 6,429,846." A464.

These designations are evidence of Immersion's compliance with Section 120. *See Promega Corp. v. Applied Biosystems, LLC*, No. 13-c-2333, 2013 WL 10734174, at *11 (N.D. Ill. April 4, 2013) (Posner, J., by designation) (stating that the priority date on a granted continuing application "is presumed correct, unless [the party challenging validity] can prove otherwise"), *aff'd* 557 F. App'x 1000 (Fed. Cir. 2014).[4] Indeed, at all times relevant to this appeal, PTO officials have been obligated to examine applicants' claims to priority under Section 120. *See, e.g.*, MPEP § 201.11, at 200-62 (8th ed. Aug. 2001 (8th Rev. July 2010)).[5] In conducting that examination, PTO procedures require examiners

[4] HTC's expert recognized as much, by relying on the prosecution history reflected on the face of the patents to aver that the '720 patent is a continuation of the '875 patent, A1182–A1183, and that the '105 patent is a continuation of the '999 patent, A1188.

[5] *See, e.g.*, MPEP § 211.01(b), at 200-53 (9th ed. Aug. 2014); *see also id.* § 201.11, at 200-62 (8th ed. Aug. 2001 (6th Rev. Aug. 2006)); *id.* § 201.11, at 200-65–200-66 (8th ed. Aug. 2001); *id.* § 201.11, at 200-52–200-53 (7th ed. July 1998 (Rev. Feb. 2000)).

to reject all priority claims when "there is no copendency between the applications"—*e.g.*, when a later application is filed after "the patent issues." *Id.* at 200-61–200-62. The MPEP even provides form paragraphs for examiners to use when rejecting non-copending applications. *See id.* Accordingly, the grant of these patents claiming earlier priority dates reflects the PTO's administrative determination that Immersion satisfied Section 120's copendency requirement.

These granted patents, by themselves, should have foreclosed summary judgment for HTC. *See, e.g.*, *Canon Comp. Sys., Inc. v. Nu-Kote Int'l, Inc.*, 134 F.3d 1085, 1088 (Fed. Cir. 1998) ("[W]here the challenger fails to identify any persuasive evidence of invalidity, the very existence of the patent satisfies the patentee's burden on the validity issue."). Both the presumption of these patents' validity, 35 U.S.C. § 282(a), and "the deference that is due to a qualified government agency presumed to have properly done its job," *PowerOasis Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1304 (Fed. Cir. 2008) (internal quotation marks omitted), bolster that conclusion. *See generally Phila. & Trenton R.R. Co. v. Stimpson*, 39 U.S. 448, 458 (1840) ("It is a presumption of law, that all public officers . . . perform their proper official duties until the contrary is proved. And where, as in the present case, an act is to be done, or patent granted upon evidence and proofs to be laid before a public officer, upon which he is to decide, the fact that he has done the act or granted the patent, is prima facie evidence that the

proofs have been regularly made, and were satisfactory."); *see also Minter v. Crommelin*, 59 U.S. 87, 88 (1855) (holding, with regard to land patents, that a patent "is *primâ facie* evidence of itself that all the incipient steps had been regularly taken before the title was perfected by the patent").

Summary judgment therefore could not be granted to HTC. Immersion's black-and-white evidence demonstrating the existence of a valid chain of continuation applications must be accepted as true, and all reasonable inferences based on it must be drawn in favor of Immersion. *See Liberty Lobby*, 477 U.S. at 255. Based on that evidence, a reasonable jury could easily conclude that HTC had not proven the invalidity of Immersion's continuation patents by clear and convincing evidence.

The same is true of any subsidiary findings necessary to conclude that there were proper continuation applications. Section 120 requires applications to be filed "before the patenting" of their parent to claim priority, 35 U.S.C. § 120, and the PTO granted Immersion's patents as proper continuation applications. Accordingly, a reasonable jury could easily draw an inference in favor of Immersion based on those granted continuation applications. *See Phila. & Trenton R.R. Co.*, 39 U.S. at 458. Based on this evidence, the jury could likewise conclude that HTC had not carried its burden of demonstrating by clear and convincing

evidence that the ’875 continuation application was filed *after* “the patenting” of the ’846 patent.

The district court’s error was compounded by the fact that, after Immersion came forward with sufficient rebuttal evidence, *Tech. Licensing*, 545 F.3d at 1327, HTC came forward with . . . nothing. HTC bore the burden of demonstrating the invalidity of Immersion’s patents at every stage of the proceeding, including on summary judgment and including with respect to the question of whether the continuation was filed “before the patenting.” 35 U.S.C. § 120; *see Tech. Licensing*, 545 F.3d at 1327. Accordingly, even assuming the district court were correct in its reading of Section 120, HTC failed to carry its ultimate burden to establish by clear and convincing evidence that Immersion’s application was *not* filed “before the patenting.” *See Nat’l State Bank*, 979 F.2d at 1583 (stressing that when the party with the ultimate burden of persuasion fails to offer any evidence on a “material fact,” it is not entitled to summary judgment, “even when the non-movant submits no evidence at all”).

The critical point is that shifts in the burden of production never relieve a challenger of its burden to prove each fact required to establish invalidity by clear and convincing evidence. *Tech. Licensing*, 545 F.3d at 1327. Indeed, regardless of a patentee’s burden of production, “the presumption of validity remains intact and the ultimate burden of proving invalidity remains with the challenger throughout

the litigation." *Innovative Scuba Concepts, Inc. v. Feder Indus., Inc.*, 26 F.3d 1112, 1115 (Fed. Cir. 1994). Because HTC never carried its ultimate burden, the district court erred in awarding it summary judgment.

C. The District Court Erred By Effectively Shifting The Burden Of Persuasion To Immersion

The district court also erred by effectively shifting the burden of persuasion from HTC to Immersion. The court faulted Immersion for failing to offer "evidence showing that the applications were filed before the parent patent issued." A7. In making that assertion, the court completely disregarded that the granted patent applications themselves are evidence in support of that proposition. *See* pp. 46–48, *supra*. And, to the extent that HTC wished to rebut that evidence, the district court erred by not requiring HTC to prove by clear and convincing evidence that the chain of priority was in fact broken.

The district court likewise misunderstood and misapplied this Court's decision in *PowerOasis*. A7; A20. *PowerOasis* involved a contention that certain patent claims were not entitled to the priority date of a parent application because the written description in the parent application allegedly did not support the later issued claims. *See* 522 F.3d at 1303. The court observed that the PTO does not generally "undertake what could be a very time consuming written description analysis simply to pronounce the effective filing date of each claim" and had not done so in the case before it. *Id.* at 1305 n.4. Under circumstances where the PTO

had not "previously considered" the adequacy of the written description, the Court perceived "no reason to presume that claims in" an "application [we]re entitled to the effective date of an earlier filed application." *Id.* at 1305. This Court then did its own analysis, rejecting the patentee's expert declaration as conclusory, and finding that the prior application lacked written support for the later claims. *Id.*

In a later case also involving a challenge to the adequacy of a written description, this Court explained that *PowerOasis* did not "modif[y] the traditional burdens rule so that the patentee has the burden of persuasion to prove it was entitled to the earlier filing date." *Tech. Licensing*, 545 F.3d at 1328. The Court explained that, "[c]arefully read," *PowerOasis* dealt only with shifting the burden of production and did not alter the "longstanding rule of patent law" that "a challenger has the burden of persuasion to show by clear and convincing evidence" that a patent is invalid. *Id.* at 1328–29. "That ultimate burden never shifts, however much the burden of going forward may jump from one party to another as the issues in the case are raised and developed." *Id.* at 1329.

The "risk of decisional uncertainty" therefore must always remain on the patent challenger. *Id.* at 1327. Accordingly, if it is unclear whether the '875 application was actually filed before the '846 patent issued, that does not mean Immersion's patents should be invalidated at summary judgment. Quite the opposite, it means that HTC did not meet its clear-and-convincing-evidence burden

of proof, and summary judgment should have been denied. *See Liberty Lobby*, 477 U.S. at 252–55; *Tech. Licensing*, 545 F.3d at 1327.

In all events, *PowerOasis* does not support the district court's decision here even without the clarification provided by *Technology Licensing*. *PowerOasis* recognized that when, as here, "'an attacker simply goes over the same ground travelled [sic] by the PTO, part of the *burden* is to show that the PTO was wrong in its decision to grant the patent.'" 522 F.3d at 1304 (quoting *Am. Hoist*, 725 F.2d at 1360 (emphasis in original)). *PowerOasis* turned on the fact that the PTO had never evaluated the adequacy of the written description. *Id.* at 1305 & n.4.

Here, by contrast, the PTO *did* assess copendency and would not have accepted the priority claim if the requirement had not been met. *See* MPEP § 211.01(b); *see also* pp. 45–48, *supra*. HTC was therefore "simply go[ing] over the same ground travelled by the PTO." *See PowerOasis*, 522 F.3d at 1304. HTC accordingly bore the burden of demonstrating by clear and convincing evidence that the PTO's administrative determination was incorrect by establishing that the two applications were in fact never copending. HTC made no attempt to do so, and it was therefore not entitled to summary judgment.

CONCLUSION

For the foregoing reasons, the district court's grant of summary judgment for HTC should be reversed.

Dated: August 5, 2015

Respectfully submitted,

/s/ Joseph R. Palmore

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ADDENDUM

Table of Contents

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

IMMERSION CORPORATION, Plaintiff, v. HTC CORPORATION, and HTC AMERICA, INC. Defendants.	Civil Action No. 12-259-RGA

MEMORANDUM OPINION

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February 11, 2015

ANDREWS, UNITED STATES DISTRICT JUDGE:

Presently before the Court are Defendants HTC Corporation and HTC America, Inc.'s Motion for Summary Judgment of Invalidity for U.S. Patent Nos. 8,059,105; 8,031,181; and 7,982,720 (D.I. 239), Motion for Summary Judgment of Non-Infringement for U.S. Patent Nos. 6,429,846; 7,982,720; 8,031,181; and 8,059,105 (D.I. 245), Motion for Summary Judgment of Non-Infringement for U.S. Patent No. 7,969,288 (D.I. 242), and Motion for Partial Summary Judgment Regarding the Damages Period for Three of the Patents-in-Suit (D.I. 233). These matters have been fully briefed. (D.I. 240, 258, 280, 246, 273, 283, 243, 269, 285, 234, 261, 288). The Court heard oral argument on the motions on November 25, 2014. For the reasons set forth herein, Defendants' Motion for Summary Judgment of Invalidity and Motion for Partial Summary Judgment Regarding the Damages Period for Three of the Patents-in-Suit are **GRANTED**. Defendants' Motion for Summary Judgment of Non-Infringement for U.S. Patent Nos. 6,429,846; 7,982,720; 8,031,181; and 8,059,105 is **GRANTED IN PART**. Summary judgment with respect to literal infringement for U.S. Patent Nos. 6,429,846 and 8,059,105 is **GRANTED**. The remainder of the motion is **DENIED**. Defendants' Motion for Summary Judgment of Non-Infringement for U.S. Patent No. 7,969,288 is **DENIED**.

I. BACKGROUND

Plaintiff Immersion Corporation filed a complaint on March 2, 2012 alleging that HTC Corporation, HTC (B.V.I.) Corporation, HTC America Holdings, Inc., HTC America, Inc., and Exedea, Inc. infringed U.S. Patent Nos. 6,429,846 ("the '846 patent"), 7,592,999 ("the '999 patent"), 7,969,288 ("the '288 patent"), 7,982,720 ("the '720 patent"), 8,031,181 ("the '181 patent"), and 8,059,105 ("the '105 patent"). (D.I. 1). The case was stayed on April 12, 2012 pending an International Trade Commission investigation. (D.I. 7). The case was reopened on

May 1, 2013 and an amended complaint was filed against HTC Corporation and HTC America, Inc. (D.I. 11). The other defendants were terminated as parties. A second amended complaint was filed on June 10, 2013, which dropped the infringement allegations with respect to the '999 patent. (D.I. 28). Defendants responded to the second amended complaint on June 28, 2013. (D.I. 33). There are no counterclaims or cross-claims. The Court recently issued its Claim Construction Opinion. (D.I. 332).

II. LEGAL STANDARD

"The court shall grant summary judgment if the movant shows that there is no genuine dispute as to any material fact and the movant is entitled to judgment as a matter of law." FED. R. CIV. P. 56(a). The moving party has the initial burden of proving the absence of a genuinely disputed material fact relative to the claims in question. *Celotex Corp. v. Catrett*, 477 U.S. 317, 330 (1986). Material facts are those "that could affect the outcome" of the proceeding, and "a dispute about a material fact is 'genuine' if the evidence is sufficient to permit a reasonable jury to return a verdict for the nonmoving party." *Lamont v. New Jersey*, 637 F.3d 177, 181 (3d Cir. 2011) (quoting *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 248 (1986)). The burden on the moving party may be discharged by pointing out to the district court that there is an absence of evidence supporting the non-moving party's case. *Celotex*, 477 U.S. at 323.

The burden then shifts to the non-movant to demonstrate the existence of a genuine issue for trial. *Matsushita Elec. Indus. Co. v. Zenith Radio Corp.*, 475 U.S. 574, 586–87 (1986); *Williams v. Borough of West Chester, Pa.*, 891 F.2d 458, 460–61 (3d Cir. 1989). A non-moving party asserting that a fact is genuinely disputed must support such an assertion by: "(A) citing to particular parts of materials in the record, including depositions, documents, electronically stored information, affidavits or declarations, stipulations . . . , admissions, interrogatory answers, or

other materials; or (B) showing that the materials cited [by the opposing party] do not establish the absence . . . of a genuine dispute . . . ." FED. R. CIV. P. 56(c)(1).

When determining whether a genuine issue of material fact exists, the court must view the evidence in the light most favorable to the non-moving party and draw all reasonable inferences in that party's favor. *Scott v. Harris*, 550 U.S. 372, 380 (2007); *Wishkin v. Potter*, 476 F.3d 180, 184 (3d Cir. 2007). A dispute is "genuine" only if the evidence is such that a reasonable jury could return a verdict for the non-moving party. *Anderson*, 477 U.S. at 247–49. If the non-moving party fails to make a sufficient showing on an essential element of its case with respect to which it has the burden of proof, the moving party is entitled to judgment as a matter of law. *See Celotex Corp.*, 477 U.S. at 322.

III. DISCUSSION

A. Invalidity

A patent claim is invalid as anticipated under 35 U.S.C. § 102 if "within the four corners of a single, prior art document . . . every element of the claimed invention [is described], either expressly or inherently, such that a person of ordinary skill in the art could practice the invention without undue experimentation." *Callaway Golf Co. v. Acushnet Co.*, 576 F.3d 1331, 1346 (Fed. Cir. 2009) (alterations in original). To determine if a patent is anticipated the court construes the claims and compares them against the prior art. *See Enzo Biochem, Inc. v. Applera Corp.*, 599 F.3d 1325, 1332 (Fed. Cir. 2010). Anticipation "may be decided on summary judgment if the record reveals no genuine dispute of material fact." *Encyclopaedia Britannica, Inc. v. Alpine Elecs. of Am., Inc.*, 609 F.3d 1345, 1349 (Fed. Cir. 2010).

Defendants argue that the '105 patent is anticipated by Japanese Patent Application No. 11-85400 ("Ogasawara"). (D.I. 240 at p. 3). The parties do not dispute that Ogasawara qualifies

as prior art under 35 U.S.C. § 102(a). (*Id.*). The parties disagree as to whether Ogasawara teaches a touch screen device that is "operative to allow the user to draw or write on the touch screen resulting in a graphical display at locations where the user has pressed the tip of an object." (*Id.* at p. 6). Defendants note that the Ogasawara specification expressly contemplates "allowing the operator to make random drawings using the pen 500." (*Id.* at p. 7). In addition, one of the figures depicts lines on a touch screen that are described as being "made by" various instruments. (*Id.*).

Plaintiff responds that Defendants do not provide any expert testimony to support their argument that Ogasawara anticipates the '105 patent. (D.I. 258 at p. 4). Plaintiff argues that its expert, Professor Balakrishnan, found that the Ogasawara patent taught tracing over existing images, not drawing new ones. (*Id.* at 6). Plaintiff argues its expert testimony, rebutted only by attorney argument, creates a triable issue of fact. (*Id.* at 8).

"Typically, testimony concerning anticipation must be testimony from one skilled in the art . . . ." *Schumer v. Lab. Computer Sys., Inc.*, 308 F.3d 1304, 1315 (Fed. Cir. 2002). Defendants have not provided any expert testimony to support their interpretation of Ogasawara. "[A]ttorney argument is not sufficient to meet the burden of persuasion on invalidity at the summary judgment motion stage." *See Carrier Corp. v. Goodman Global, Inc.*, 2014 WL 3976575, at *7 (D. Del. Aug. 14, 2014). Professor Balakrishnan's declaration provides evidence raising a genuine issue of material fact; it is a question for the jury how credible it is. The Court therefore denies summary judgment on the ground that Ogasawara anticipates the '105 patent.

Defendants also argue that the '720, '181, and '105 patents are invalid because they were not filed "before" their parent patent issued. (D.I. 240 at p. 11). 35 U.S.C. § 120 allows a patent application to have the priority date of a previously filed application "if filed before the patenting

. . . on the first application . . . ." A foreign patent application with an identical specification was filed more than one year before the '720, '181, and '105 patent applications were filed. (D.I. 240 at p. 1). If the '720, '181, and '105 patents are not treated as continuations with the benefit of an earlier priority date, they would be anticipated by the foreign application.

The '846 patent, the parent patent from which the '720, '181, and '105 patent applications claim priority, was issued on August 6, 2002, the same day that the '720, '181, and '105 patent applications were filed. (D.I. 240 at p. 13). Defendants argue that patents issue automatically at 12:00:01 a.m. on their issue date, and therefore Plaintiff could not have filed the applications "before" the '846 patent issued. (*Id.*).

Plaintiff responds that the Patent and Trademark Office ("PTO") has long given continuation applications the priority date of a prior application if the continuation is filed on the same day that the prior application issues as a patent. (D.I. 258 at p. 16). The PTO makes its position clear in the Manual of Patent Examining Procedure, which states, "If the prior application issues as a patent, it is sufficient for the later-filed application to be copending with it if the later-filed application is filed on the same date, or before the date that the patent issues on the prior application." (Manual of Patent Examining Procedure § 211.01(b)(I) (2014)). Plaintiff argues that the Court should give *Chevron* deference to the PTO. (D.I. 258 at p. 15).

The Federal Circuit left open the question of "whether filing a continuation on the day the parent issues results in applications that are co-pending as required by the statute." *Encyclopaedia Britannica, Inc. v. Alpine Electronics of Am., Inc.*, 609 F.3d 1345, 1352 (Fed. Cir. 2010). Plaintiff notes that one district court has adopted the PTO's position. (D.I. 258 at p. 13). In *MOAEC, Inc. v. MusicIP Corp.*, the district court interpreted "'before' to mean 'not later

than'" and allowed a continuation filed the same day that the parent patent issued to have the parent's priority date. 568 F. Supp. 2d 978, 982 (W.D. Wis. 2008).

The Court does not agree with Plaintiff that the PTO is entitled to *Chevron* deference on this issue. A court only defers to an administrative agency's construction of a statute where "the statute is silent or ambiguous with respect to the specific issue." *Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 843 (1984). 35 U.S.C. § 120 is not silent on when a continuation must be filed in order to get the parent's priority date. Nor is it ambiguous. It expressly states that the application must be filed "before" the parent application issues.[1]

Plaintiff has the burden of going forward to prove entitlement to an earlier priority date. *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1329 (Fed. Cir. 2008); *PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1305-06 (Fed. Cir. 2008). In this case, that means that Plaintiff has the burden of producing some evidence that it filed the continuation applications before the parent patent issued on August 6, 2002. The Court is not convinced of the correctness of Defendants' contention that a patent automatically issues at 12:00:01 a.m. on the issue day. Nevertheless, Plaintiff has presented no evidence of when on August 6, 2002 the applications were filed. Thus, no matter when the parent patent issued on August 6, 2002, Plaintiff has presented no evidence showing that the applications were filed before the parent patent issued. It is Plaintiff's burden to come forward with some evidence. It has not. Plaintiff has therefore not shown that the '720, '181, and '105 patent applications have a priority date earlier than August 6, 2002.

[1] The PTO understands the ordinary meaning of "before." As the previously quoted portion of the Manual of Patent Examining Procedure shows, the PTO defines "copending" as being "on the same date, or before the date." The PTO recognized that "before" is different than "the same."

It is not contested that foreign counterpart applications for the '846 patent were published more than one year before August 6, 2002. (D.I. 240 at p. 14). The foreign applications share an identical specification to the '846, '720, '181, and '105 patents. (*Id.*). Because the specifications are identical, they expressly teach each and every limitation of the patents, and therefore anticipate them. As a result, the Court holds that the '720, '181, and '105 patents are invalid as anticipated. I therefore grant Defendants' motion for summary judgment for invalidity of the '720, '181, and '105 patents.

B. Non-Infringement[2]

A patent is infringed when a person "without authority makes, uses or sells any patented invention, within the United States . . . during the term of the patent." 35 U.S.C. § 271(a). A two-step analysis is employed in making an infringement determination. *See Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 976 (Fed. Cir. 1995) (en banc), *aff'd*, 517 U.S. 370 (1996). First, the court must construe the asserted claims to ascertain their meaning and scope. *See id.* The trier of fact must then compare the properly construed claims with the accused infringing product. *See id.* This second step is a question of fact. *See Bai v. L & L Wings, Inc.*, 160 F.3d 1350, 1353 (Fed. Cir. 1998).

"Literal infringement of a claim exists when every limitation recited in the claim is found in the accused device." *Kahn v. Gen. Motors Corp.*, 135 F.3d 1472, 1477 (Fed. Cir. 1998). "If any claim limitation is absent from the accused device, there is no literal infringement as a matter of law." *Bayer AG v. Elan Pharm. Research Corp.*, 212 F.3d 1241, 1247 (Fed. Cir. 2000). If an accused product does not infringe an independent claim, it also does not infringe any claim depending thereon. *See Wahpeton Canvas Co. v. Frontier, Inc.*, 870 F.2d 1546, 1553 (Fed. Cir.

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[2] Although I find that the '720, '181, and '105 patents are invalid as anticipated, I will nevertheless address the non-infringement arguments.

1989). However, "[o]ne may infringe an independent claim and not infringe a claim dependent on that claim." *Monsanto Co. v. Syngenta Seeds, Inc.*, 503 F.3d 1352, 1359 (Fed. Cir. 2007) (internal quotations omitted). A product that does not literally infringe a patent claim may still infringe under the doctrine of equivalents if the differences between an individual limitation of the claimed invention and an element of the accused product are insubstantial. *See Warner–Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 24 (1997). The patent owner has the burden of proving infringement and must meet its burden by a preponderance of the evidence. *See SmithKline Diagnostics, Inc. v. Helena Lab. Corp.*, 859 F.2d 878, 889 (Fed. Cir. 1988) (citations omitted).

When an accused infringer moves for summary judgment of non-infringement, such relief may be granted only if at least one limitation of the claim in question does not read on an element of the accused product, either literally or under the doctrine of equivalents. *See Chimie v. PPG Indus., Inc.*, 402 F.3d 1371, 1376 (Fed. Cir. 2005); *see also TechSearch, L.L.C. v. Intel Corp.*, 286 F.3d 1360, 1369 (Fed. Cir. 2002) ("Summary judgment of noninfringement is . . . appropriate where the patent owner's proof is deficient in meeting an essential part of the legal standard for infringement, because such failure will render all other facts immaterial."). Thus, summary judgment of non-infringement can only be granted if, after viewing the facts in the light most favorable to the non-movant, there is no genuine issue as to whether the accused product is covered by the claims (as construed by the court). *See Pitney Bowes, Inc. v. Hewlett–Packard Co.*, 182 F.3d 1298, 1304 (Fed. Cir. 1999).

1. <u>'846 and '105 Patents</u>

Defendants argue that the accused products do not infringe the asserted claims of the '846 and '105 patents because the actuators do not impart forces "directly" on the touch screen. (D.I.

246 at p. 5). The asserted claim of the '105 patent requires an actuator configured to "impart a force directly to the touch screen." (*Id.*). The Court construed that term to mean "impart a force on the touch screen without intervening structure." (D.I. 332 at 11). The asserted claims of the '846 patent all require an actuator "outputting a force directly on said touch input device." (D.I. 246 at p. 5). The Court construed that term to mean "outputting a force on the touch screen without intervening structure." (D.I. 332 at 10).

The Court's constructions of the touch screen terms are also central to the infringement issue. The Court construed "touch input device" to mean "device that allows a user to provide input by touching an area on the device, and may include a touch surface, a display, and a touch sensor." (*Id.* at 4). The Court construed "touch screen" to mean "a display device that allows a user to provide input by touching an area on the device, and may include a touch surface, a display, and a touch sensor." (*Id.* at 5).

Defendants argue that the accused devices do not literally infringe because there is always an intervening structure between the device and the actuator, namely the "chassis" or "bezel."[3] (D.I. 246 at p. 7). Plaintiff's argument rests on constructions that the Court did not adopt. Plaintiff argues that the bezel is part of the touch screen, so an actuator attached to the bezel is directly attached to the touch screen. (D.I. 273 at p. 9). This argument is unavailing because the bezel is not part of the touch screen under the Court's construction. Alternately, Plaintiff argues that "directly" can mean "through connected rigid bodies," and because the bezel is rigid, the force is imparted "directly." (*Id.* at p. 13). However, the Court did not adopt that construction. (*See* D.I. 332 at 10-11). Plaintiff did not present any argument that the accused devices literally infringe under Defendants' construction of the terms.

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[3] The "chassis" or "bezel" is a rigid body that binds some or all of the other layers of the device together. (D.I. 273 at p. 10; D.I. 246 at p. 7).

Under the Court's construction of the terms discussed above, none of the devices literally infringe because there is always a bezel between the actuator and the touch screen. The Court therefore grants summary judgment to Defendants with respect to literal infringement of the '846 and '105 patents.

Plaintiff further argues that the devices infringe under the doctrine of equivalents because the precise location of the actuator does not substantially affect the actuator's function or the way it achieves the result. (D.I. 273 at p. 17). Plaintiff has provided expert testimony to support its argument. (*Id.* at pp. 17-18). Equivalence is a question of fact that requires consideration of "credibility, persuasiveness and weight of evidence." *Graver Tank & Mfg. Co. v. Linde Air Products Co.*, 339 U.S. 605, 609-10 (1950). "Infringement under the doctrine of equivalents is not equitable in nature and is triable as of right to the jury." *Carbide Blast Joints, Inc. v. Rickert Precision Indus., Inc.*, 73 F.3d 379 (Fed. Cir. 1995). Plaintiff's evidence raises a genuine issue of material fact that must be submitted to the jury, and the Court therefore denies summary judgment of non-infringement of the '846 and '105 patents under the doctrine of equivalents.

2. <u>'720 and '181 Patents</u>

All asserted claims of the '720 and '181 patents require "a first region associated with cursor positioning" and a second region "not related to cursor positioning." (D.I. 246 at p. 15). The parties agree that the virtual keys, a series of buttons such as "Menu," "Search," and "Home" at the bottom of the devices, are the second region. (*Id.* at pp. 15-16). They dispute whether the keys meet the "not related to cursor positioning" limitation. (*Id.* at p. 15; D.I. 273 at

p. 18). The Court construed "cursor" to mean "movable, visible mark used to indicate a position of interest on a display device."[4] (D.I. 332 at 6).

Defendants argue that the virtual keys are related to cursor positioning because they can call up a cursor in the first region when pressed. (D.I. 246 at p. 17). For example, when a user presses the "Search" key, a text box with a blinking text caret, which Plaintiff argues is a cursor, is called up to the screen. (*Id.*). Defendants further argue that the "Back" button may take the user back to a screen with a text caret as well. (*Id.*). Thus, even though the virtual keys cannot display a cursor, they are nevertheless "related to cursor positioning." (D.I. 283 at p. 9).

Plaintiff argues that the virtual keys are physically incapable of displaying a cursor, and can therefore not be "related to cursor positioning." (D.I. 273 at p. 18). Plaintiff argues that the "Search" key runs a search application, which in turn positions the cursor. (*Id.* at 18). Thus, the virtual key does not contribute to positioning the cursor, but is merely a control area that runs a search program. (*Id.*).

Whether a text caret is a cursor is a question of fact properly determined by the jury. *See Markman*, 52 F.3d at 976. Similarly, whether the virtual keys are "related to cursor positioning" by virtue of triggering applications is a genuine issue of material fact. The Court therefore denies summary judgment of non-infringement of the '720 and '181 patents.

3. <u>'288 Patent</u>

Claim 18 of the '288 patent is a method claim for delivering haptic feedback on a device performing multiple tasks. (D.I. 243 at p. 4). Defendants argue that they are entitled to summary judgment of non-infringement because the accused devices do not perform the step of

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[4] Because the Court adopted the above construction, it will not address the arguments relating to infringement under Plaintiff's proposed construction, which was broader than the Court's and included light as an example of a "cursor."

"determining which one of a plurality of concurrently running application programs is active in the multi-tasking environment." (*Id.*). Defendants argue that the accused devices do not perform this step because a program does not need to be active to provide haptic feedback. (*Id.* at p. 6). For example, a phone can vibrate when receiving a call without the phone function being active. (*Id.*). Defendants further note that Plaintiff has not identified any source code that performs an active determining step. (D.I. 285 at p. 6).

Plaintiff responds that as part of the process of bringing an application to the foreground, the device must change the values of system variables, change the flags for the process records associated with the applications, and set up internal connections to send information to the active application.[5] (D.I. 169 at pp. 9-10). Plaintiff puts forth expert testimony that none of these actions could be performed unless the devices determined which application is active. (*Id.* at p. 7).

"It is hornbook law that direct evidence of a fact is not necessary. Circumstantial evidence is not only sufficient, but may also be more certain, satisfying and persuasive than direct evidence." *Moleculon Research Corp. v. CBS, Inc.*, 793 F.2d 1261, 1272 (Fed. Cir. 1986) (internal quotation marks and citations omitted), *abrogated on other grounds by Egyptian Goddess, Inc. v. Swisa, Inc.*, 543 F.3d 665 (Fed. Cir. 2008) (en banc). While Defendants are correct that Plaintiff has not identified any source code that performs the determining step, Plaintiff is not required to do so. Plaintiff agrees that none of the three examples it identifies actually performs the determining step, but argues that they reflect that the determining step has been performed. (D.I. 324 at 107). Such circumstantial evidence, supported by expert

[5] Defendants requested that the Court strike these arguments because they were not disclosed in the experts' reports or depositions. (D.I. 285 pp. 2-4). The Court finds that the factual underpinnings of the arguments were disclosed, and will therefore not strike the theories.

declarations, is sufficient to raise a genuine issue of material fact. The Court therefore denies summary judgment of non-infringement of the '288 patent.

C. Damages Period

Defendants seek partial summary judgment that Plaintiff cannot collect damages on the '288 patent prior to February 10, 2014, when the patent reissued with amended claim language.[6] (D.I. 234 at p. 1).[7] During reexamination, claim 18 of the '288 patent was amended to add "concurrently running" to the step of "determining which of a plurality of *concurrently running* applications is active." (*Id.* at p. 2).

If a patent is reissued, damages are available for the period between the original issuance and the issuance of the reexamined claims only if the original claims and reexamined claims are "identical." *Laitram Corp. v. NEC Corp.*, 163 F.3d 1342, 1346 (Fed. Cir. 1998). "Reexamined claims are 'identical' to their original counterparts if they are 'without substantive change.' . . . If substantive changes have been made to the original claims, the patentee is entitled to infringement damages only for the period following the issuance of the reexamination certificate." *Id.*

In determining "whether a claim change is substantive it is necessary to analyze the claims of the original and the reexamined patents in light of the particular facts, including the prior art, the prosecution history, other claims, and any other pertinent information." *Id.* at 1347. A change made in response to a prior art rejection is not *per se* substantive. *Id.* Nevertheless, amendments that overcome a rejection are "highly influential" because "it is difficult to conceive

[6] Defendants do not specifically state that the reexamination certificate issued on February 10, 2014, but the Court assumes the certificate issued on that date based on the argument as a whole.
[7] Defendants also seek partial summary judgment limiting the damages periods for the '720 and '181 patents. (D.I. 234 at p. 1). Because the Court finds those patents invalid as anticipated, *see supra* III.A., I will not address the arguments with respect to the '720 and '181 patents.

of many situations in which the scope of a rejected claim that became allowable when amended is not substantively changed by the amendment." *Id.* at 1348.

Defendants argue that adding "concurrently running" substantively changed the claim. (D.I. 234 at p. 2). Plaintiff responds that adding "concurrently running" was a clarifying amendment that did not affect the scope of the claim. (D.I. 261 at p. 3). Plaintiff argues that having a plurality of concurrently running applications was an inherent claim requirement, and the amendment made explicit what was already implicit. (*Id.* at pp. 3, 7). Plaintiff cites to many instances in the specification referring to multiple programs running. (*Id.* at pp. 5-7). Plaintiff argues that "[r]eading the claim in light of the specification, a person of ordinary skill in the art would understand that each of the claimed applications is running, which inherently means that they are concurrently running programs . . . ." (*Id.* at p. 7).

The Court finds that the amendment substantively changed the scope of the claim. While the specification is a relevant consideration, Plaintiff's argument that having multiple programs is inherent in the claim because it is disclosed in the specification is contrary to the "well-established principle that a court may not import limitations from the written description into the claims." *See Laitram*, 163 F.3d at 1347. The group of programs in the original claim language could have included programs that were not running. Requiring that the programs be concurrently running narrows the claim. Moreover, though not dispositive, it is highly persuasive that the patent examiner allowed the amended claim only after "concurrently running" was added because the prior art made "no reference to any other programs that are running concurrently and how the determination is made between the plurality of concurrently running programs . . . ." ('288 reexamination, Notice of Reexamination certificate at 5-6 (Jan. 15,

2014)). Because the scope of the original claims and reexamination claims is not identical, the Court grants Defendants' motion for partial summary judgment.

IV. CONCLUSION

For the reasons set forth herein, Defendants' Motion for Summary Judgment of Invalidity (D.I. 239) and Motion for Partial Summary Judgment Regarding the Damages Period for Three of the Patents-in-Suit (D.I. 233) are **GRANTED**. Defendants' Motion for Summary Judgment of Non-Infringement for U.S. Patent Nos. 6,429,846; 7,982,720; 8,031,181; and 8,059,105 (D.I. 245) is **GRANTED IN PART**. Summary judgment with respect to literal infringement for U.S. Patent Nos. 6,429,846 and 8,059,105 is **GRANTED**. The remainder of the motion is **DENIED**. Defendants' Motion for Summary Judgment of Non-Infringement for U.S. Patent No. 7,969,288 (D.I. 242) is **DENIED**.

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

IMMERSION CORPORATION, Plaintiff, v. HTC CORPORATION, and HTC AMERICA, INC. Defendants.	Civil Action No. 12-259-RGA

ORDER

Having reviewed the relevant papers, for the reasons stated in the accompanying Memorandum Opinion, **IT IS ORDERED**:

Defendants' Motion for Summary Judgment of Invalidity (D.I. 239) and Motion for Partial Summary Judgment Regarding the Damages Period for Three of the Patents-in-Suit (D.I. 233) are **GRANTED**. Defendants' Motion for Summary Judgment of Non-Infringement for U.S. Patent Nos. 6,429,846; 7,982,720; 8,031,181; and 8,059,105 (D.I. 245) is **GRANTED IN PART**. Summary judgment with respect to literal infringement for U.S. Patent Nos. 6,429,846 and 8,059,105 is **GRANTED**. The remainder of the motion is **DENIED**. Defendants' Motion for Summary Judgment of Non-Infringement for U.S. Patent No. 7,969,288 (D.I. 242) is **DENIED**.

Entered this 11th day of February, 2015.

Richard G. Andrews

United States District Judge

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

IMMERSION CORPORATION, Plaintiff, v. HTC CORPORATION, and HTC AMERICA, INC. Defendants.	Civil Action No. 12-259-RGA

Having reviewed Plaintiff's Motion for Reargument (D.I. 338) and Defendants' response (D.I. 347), it is **ORDERED** that Plaintiff's motion is **DENIED** for the reasons that follow:

1. Plaintiff has asked the Court to reconsider its grant of summary judgment on the ground that the Court "incorrectly shifted the burden of proving validity" to Plaintiff. (D.I. 338 at p. 2).

2. To grant Plaintiff's motion, I must find, in my discretion, that Plaintiff demonstrated one of the following: (1) a change in the controlling law, (2) a need to correct a clear error of law or fact, or to prevent manifest injustice, or (3) availability of new evidence not available when the judgment was granted. Motions for reargument or reconsideration may not be used as a means to argue new facts or issues that inexcusably were not presented to the Court

in the matter previously decided. *Apeldyn Corp. v. AU Optronics Corp.*, 2011 WL 6357773, *1 (D. Del. Dec. 19, 2011).

3. Plaintiff does not proffer evidence of a change in controlling law.

4. Plaintiff does not present new evidence that was not available at the time of the hearing.

5. Plaintiff does argue that there is an error of law. Namely, Plaintiff argues that I improperly shifted the burden of persuasion to Plaintiff. Not so. The Court did not find—nor could it—that the ultimate burden of proving invalidity by clear and convincing evidence shifted to Plaintiff. Rather, the Court held that once an alleged infringer presents evidence of anticipatory prior art, the burden of going forward shifts to the patentee to produce some evidence that the patent is entitled to an earlier priority date. (D.I. 333 at p. 7; *see Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1329 (Fed. Cir. 2008); *PowerOasis, Inc. v. T–Mobile USA, Inc.*, 522 F.3d 1299, 1305-06 (Fed. Cir. 2008)).

6. Plaintiff contends that it has met that burden. (D.I. 338 at p. 7). Plaintiff notes, "The evidence in the summary judgment record is that an application was deposited with the U.S. Postal Service at some time during the day on August 6, 2002, and that a patent issued at some time during the day on August 6, 2002." (*Id.* at p. 9). Based on that record, Plaintiff argues that "[b]ecause there is a lack of evidence establishing the necessary facts, summary judgment is not proper." (*Id.*). But the lack of evidence is precisely why Plaintiff did not meet its burden of coming forward with evidence. When there is no evidence on either side of an issue, the party with the burden of going forward loses. Here, there is evidence that two things occurred on August 6, 2002. Plaintiff offered no evidence of which occurred first, and therefore did not meet its burden of production.

7. Thus, the motion to reconsider does not meet the standard for reconsideration, and it is denied.

Entered this 3rd day of March, 2015.

Richard G. Andrews

United States District Judge

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

IMMERSION CORPORATION,	)	
	)	
Plaintiff,	)	
	)	C.A. No. 12-259-TBD
v.	)	
	)	
HTC CORPORATION and HTC AMERICA, INC.,	)	
	)	
Defendants.	)	

FINAL JUDGMENT

In view of the parties' agreement and the Court's Summary Judgment Order (D.I. 333 and 334), the Court enters Judgment as follows:

1) HTC does not infringe U.S. Patent Nos. 8,059,105; 8,031,181; and 7,982,720 solely because the Court ordered that HTC prevailed on its Twelfth Affirmative Defense of invalidity as a matter of law and no other part of the summary judgment order is essential or necessary to this judgment;

2) Immersion's claims of infringement of U.S. Pat. Nos. 6,429,846 and 7,969,288 and HTC's defenses thereto shall be dismissed with prejudice except insofar as this Court shall retain exclusive, continuing jurisdiction to enforce, administer, and/or interpret this Stipulated Judgment and Order; and

3) Immersion and HTC shall each bear their own legal costs and attorneys' fees incurred in this action.

Immersion reserves its rights to challenge on appeal the Court's Summary Judgment Order (D.I. 333 and 334) with respect to the invalidity of U.S. Patent Nos. 8,059,105; 8,031,181; and 7,982,720 and the order denying Immersion's motion for reargument (D.I. 348). Immersion will not challenge on appeal the Court's orders that were not essential or necessary to this judgment, including the interlocutory orders regarding claim construction and the grant of summary judgment to HTC with respect to literal infringement of U.S. Patent No. 8,059,105.

This is a final, appealable judgment.

IT IS SO ORDERED.

March 31, 2015

Honorable Timothy B. Dyk
United States Circuit Judge
Of the United States Court of Appeals for the Federal Circuit, sitting by designation

US008059105B2

(12) **United States Patent**
Rosenberg et al.

(10) **Patent No.: US 8,059,105 B2**
(45) **Date of Patent: Nov. 15, 2011**

(54) **HAPTIC FEEDBACK FOR TOUCHPADS AND OTHER TOUCH CONTROLS**

(75) Inventors: **Louis B. Rosenberg**, San Jose, CA (US); **James R. Riegel**, Santa Clara, CA (US)

(73) Assignee: **Immersion Corporation**, San Jose, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 955 days.

(21) Appl. No.: **12/008,916**

(22) Filed: **Jan. 14, 2008**

(65) **Prior Publication Data**

US 2008/0111788 A1 May 15, 2008

Related U.S. Application Data

(63) Continuation of application No. 11/405,811, filed on Apr. 17, 2006, now Pat. No. 7,592,999, which is a continuation of application No. 10/213,940, filed on Aug. 6, 2002, now Pat. No. 7,148,875, which is a continuation of application No. 09/487,737, filed on Jan. 19, 2000, now Pat. No. 6,429,846, which is a continuation-in-part of application No. 09/467,309, filed on Dec. 17, 1999, now Pat. No. 6,563,487, which is a continuation-in-part of application No. 09/253,132, filed on Feb. 18, 1999, now Pat. No. 6,243,078, which is a continuation-in-part of application No. 09/156,802, filed on Sep. 17, 1998, now Pat. No. 6,184,868, which is a continuation-in-part of application No. 09/103,281, filed on Jun. 23, 1998, now Pat. No. 6,088,019.

(51) **Int. Cl.**
G06F 3/041 (2006.01)

(52) **U.S. Cl.** **345/173**; 178/18.01; 463/30

(58) **Field of Classification Search** 345/156, 345/173; 178/18.01; 463/30; 715/701
See application file for complete search history.

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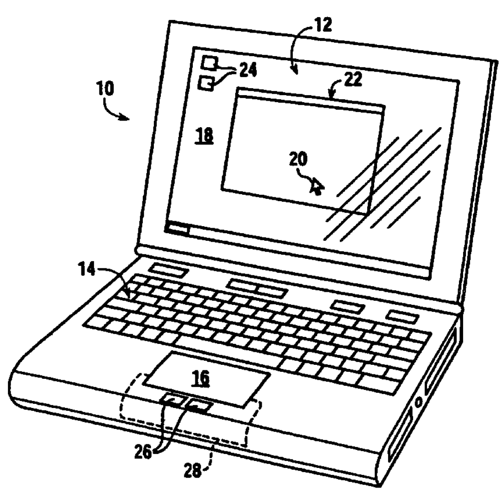
Primary Examiner — Abbas Abdulselam
(74) *Attorney, Agent, or Firm* — Womble Carlyle Sandridge & Rice, PLLC

(57) **ABSTRACT**

A haptic feedback planar touch control used to provide input to a computer. A touch input device includes a planar touch surface that inputs a position signal to a processor of the computer based on a location of user contact on the touch surface. The computer can position a cursor in a displayed graphical environment based at least in part on the position signal, or perform a different function. At least one actuator is also coupled to the touch input device and outputs a force to provide a haptic sensation to the user contacting the touch surface. The touch input device can be a touchpad separate from the computer's display screen, or can be a touch screen. Output haptic sensations on the touch input device can include pulses, vibrations, and spatial textures. The touch input device can include multiple different regions to control different computer functions.

21 Claims, 5 Drawing Sheets



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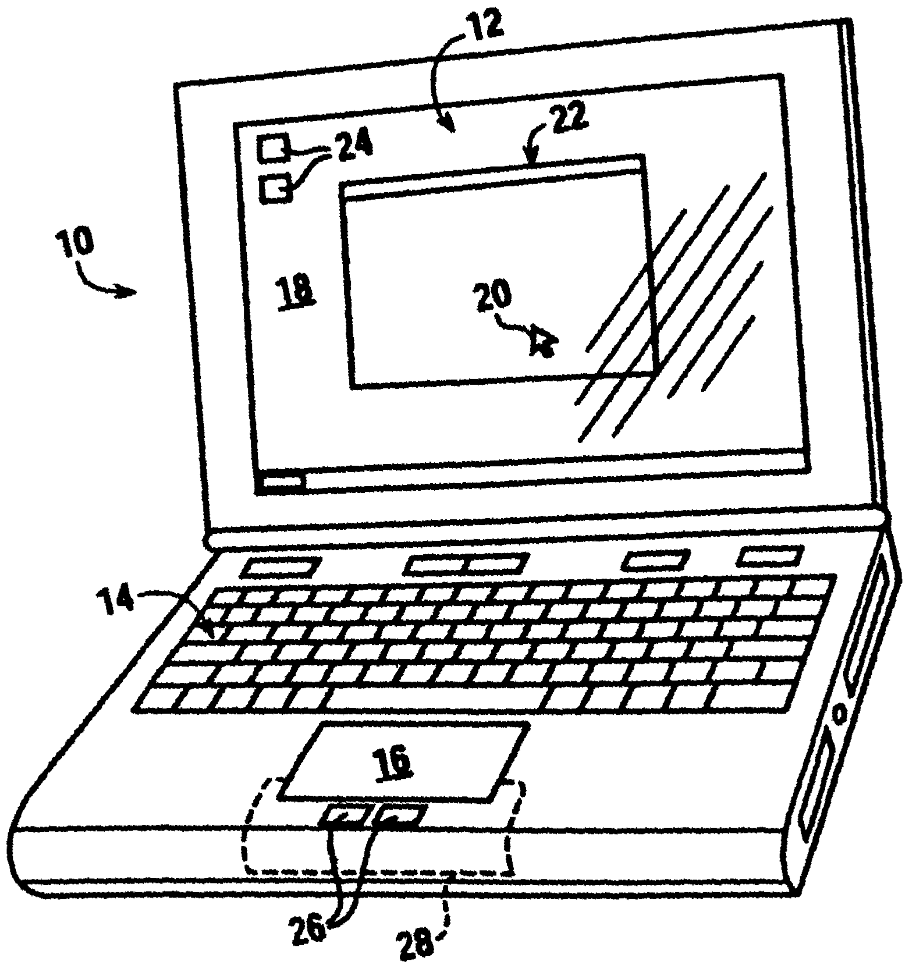

FIG. 1

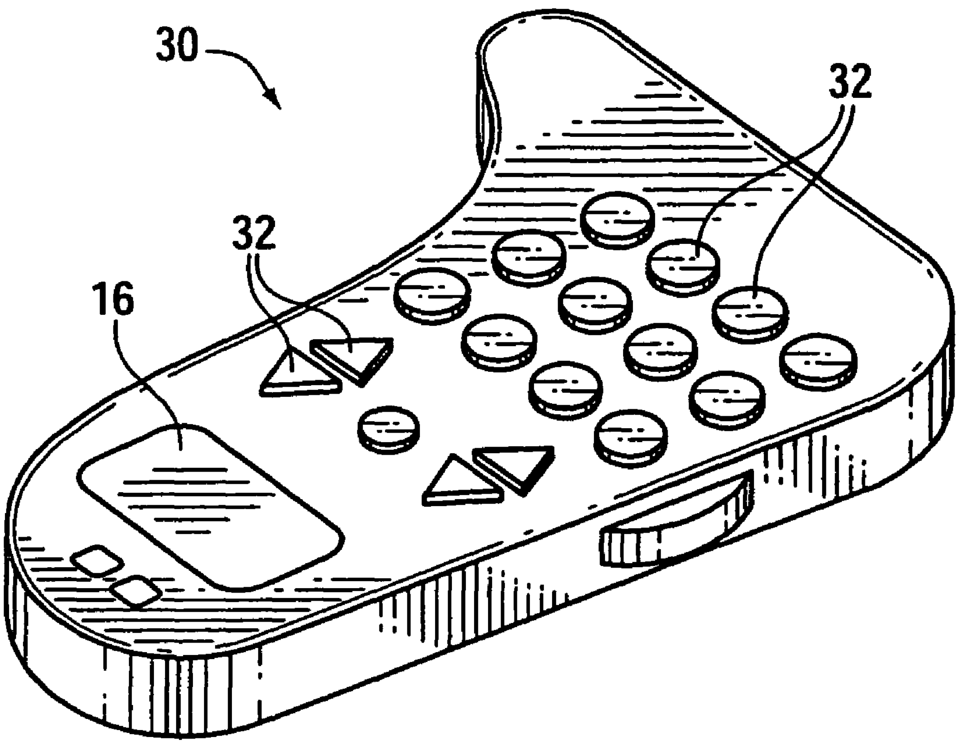

FIG. 2

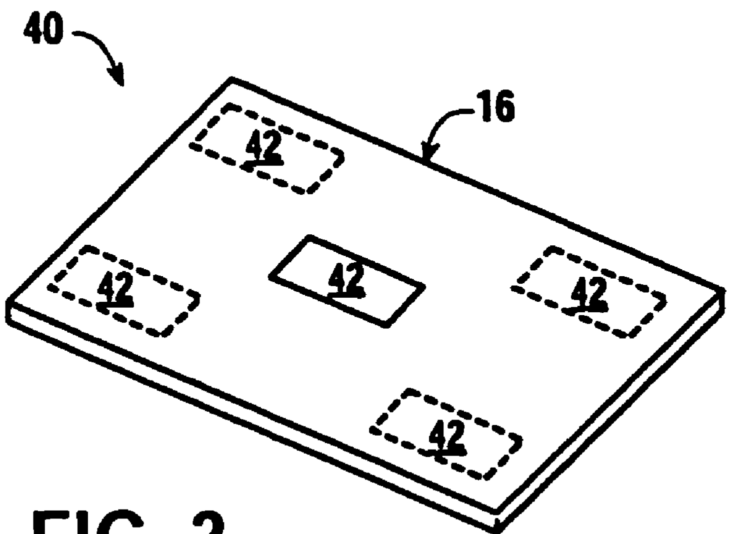

FIG. 3

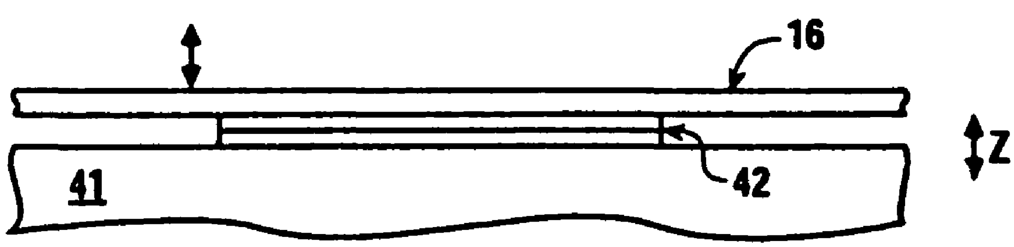

FIG. 4

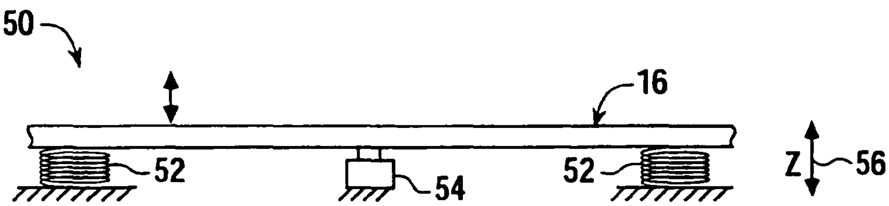

FIG. 5

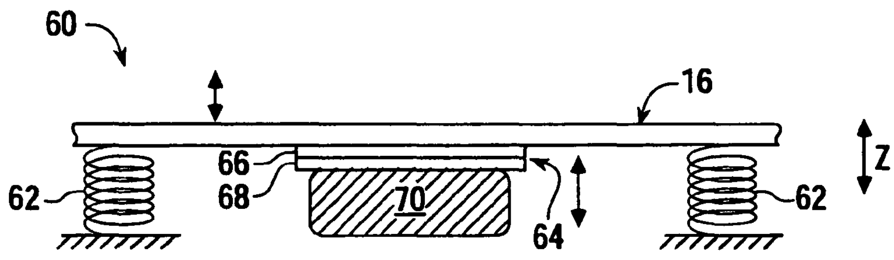

FIG. 6

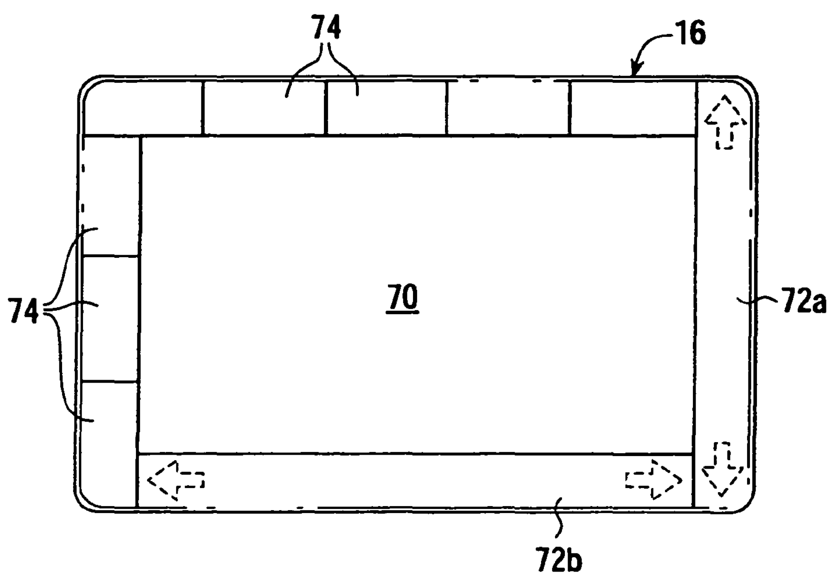

FIG. 7

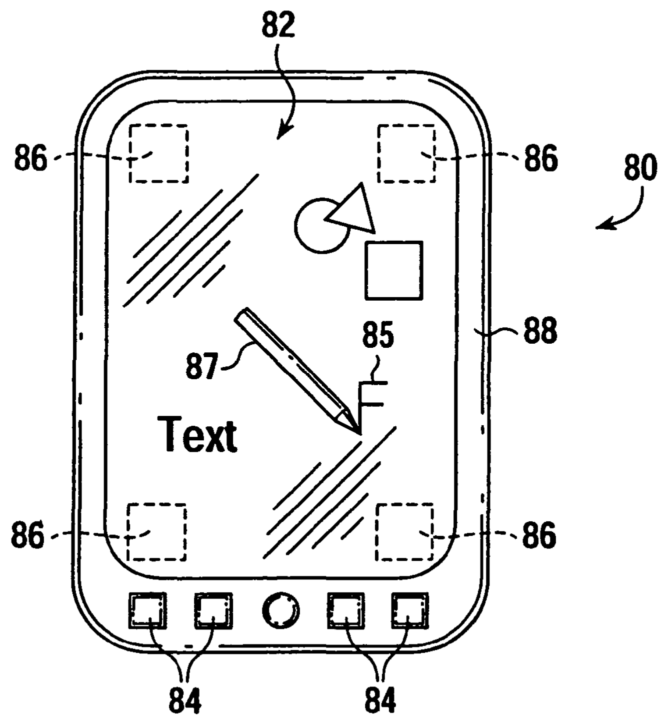

FIG. 8A

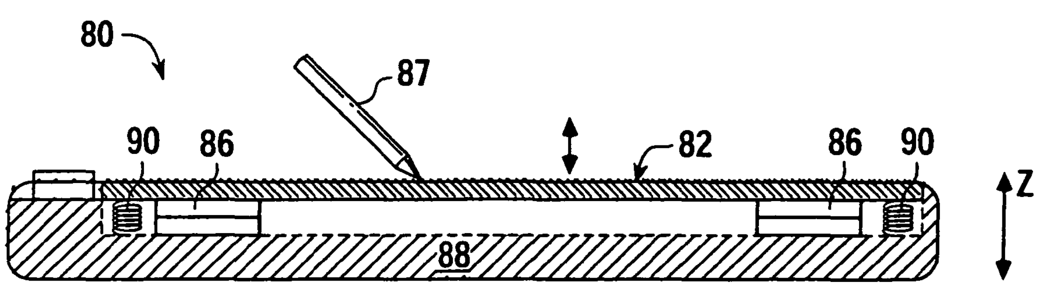

FIG. 8B

HAPTIC FEEDBACK FOR TOUCHPADS AND OTHER TOUCH CONTROLS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 11/405,811 entitled "Haptic Feedback for Touchpads and Other Touch Controls," filed Apr. 17, 2006, which is a continuation of U.S. Pat. No. 7,148,875, entitled "Haptic Feedback for Touchpads and Other Touch Controls," issued Dec. 12, 2006, which is a continuation of U.S. Pat. No. 6,429,846, entitled "Haptic Feedback for Touchpads and Other Touch Controls," issued Aug. 6, 2002, which is a continuation-in-part of U.S. Pat. No. 6,563,487, entitled "Haptic Feedback for Directional Control Pads," issued May 13, 2003, which is a continuation-in-part of U.S. Pat. No. 6,243,078, entitled "Low Cost Force Feedback Pointing Device," issued Jun. 5, 2001, which is a continuation-in-part of U.S. Pat. No. 6,184,868, entitled "Haptic Feedback Control Devices," issued Feb. 6, 2001, which is a continuation-in-part of U.S. Pat. No. 6,088,019, entitled "Low Cost Force Feedback Device with Actuator for Non-Primary Axis," issued Jul. 11, 2000.

BACKGROUND

The subject matter described relates generally to the interfacing with computer and mechanical devices by a user, and more particularly to devices used to interface with computer systems and electronic devices and which provide haptic feedback to the user.

Humans interface with electronic and mechanical devices in a variety of applications, and the need for a more natural, easy-to-use, and informative interface is a constant concern. In the context, humans interface with computer devices for a variety of applications. One such application is interacting with computer-generated environments such as games, simulations, and application programs. Computer input devices such as mice and trackballs are often used to control a cursor within a graphical environment and provide input in these applications.

In some interface devices, force feedback or tactile feedback is also provided to the user, collectively known herein as "haptic feedback." For example, haptic versions of joysticks, mice, gamepads, steering wheels, or other types of devices can output forces to the user based on events or interactions occurring within the graphical environment, such as in a game or other application program.

In portable computer or electronic devices, such as laptop computers, mice typically too large a workspace to be practical. As a result, more compact devices such as trackballs are often used. A more popular device for portable computers are "touchpads," which are small rectangular, planar pads provided near the keyboard of the computer. The touchpads senses the location of a pointing object by any of a variety of sensing technologies, such as capacitive sensors or pressure sensors that detect pressure applied to the touchpad. The user contacts the touchpad most commonly with a fingertip and moves his or her finger on the pad to move a cursor displayed in the graphical environment. In other embodiments, the user can operate a stylus in conjunction with the touchpad by pressing the stylus tip on the touchpad and moving the stylus.

One problem with existing touchpads is that there is no haptic feedback provided to the user. The user of a touchpad is therefore not able to experience haptic sensations that assist and inform the user of targeting and other control tasks within

the graphical environment. The touchpads of the prior art also cannot take advantage of existing haptic-enabled software run on the portable computer.

OVERVIEW

An embodiment is directed to a haptic feedback planar touch control used to provide input to a computer system. The control can be a touchpad provided on a portable computer, or can be a touch screen found on a variety of devices. The haptic sensations output on the touch control enhance interactions and manipulations in a displayed graphical environment or when controlling an electronic device.

More specifically, the embodiment relates to a haptic feedback touch control for inputting signals to a computer and for outputting forces to a user of the touch control. The control includes a touch input device including an approximately planar touch surface operative to input a position signal to a processor of said computer based on a location of user contact on the touch surface. The computer positions a cursor in a graphical environment displayed on a display device based at least in part on the position signal. At least one actuator is also coupled to the touch input device and outputs a force on the touch input device to provide a haptic sensation to the user contacting the touch surface. The actuator outputs the force based on force information output by the processor to the actuator.

The touch input device can be a touchpad separate from a display screen of the computer, or can be included in a display screen of the computer as a touch screen. The touch input device can be integrated in a housing of the computer or handheld device, or provided in a housing that is separate from the computer. The user contacts the touch surface with a finger, a stylus, or other object. The force is preferably a linear force output approximately perpendicularly to a plane of the touch surface of the touch input device, and the actuator can include a piezo-electric actuator, a voice coil actuator, a pager motor, a solenoid, or other type of actuator. In one embodiment, the actuator is coupled between the touch input device and a grounded surface. In another embodiment, the actuator is coupled to an inertial mass, wherein said actuator outputs an inertial force on the touch input device approximately along an axis perpendicular to the planar touch surface. A touch device microprocessor separate from the main processor of the computer can receive force information from the host computer and provide control signals based on the force information to control the actuator.

The haptic sensations, such as a pulse, vibration, or spatial texture, are preferably output in accordance with an interaction of a controlled cursor with a graphical object in the graphical environment. For example, a pulse can be output when the cursor is moved between menu elements in a menu, moved over said icon, or moved over a hyperlink. The touch input device can include multiple different regions, where at least one of the regions provides the position signal and at least one other region provides a signal that is used by the computer to control a different function, such as rate control function of a value or a button press. Different regions and borders between regions can be associated with different haptic sensations.

An embodiment advantageously provides haptic feedback to a planar touch control device of a computer, such as a touchpad or touch screen. The haptic feedback can assist and inform the user of interactions and events within a graphical user interface or other environment and ease cursor targeting tasks. Furthermore, an embodiment allows portable computer devices having such touch controls to take advantage of exist-

ing haptic feedback enabled software. The haptic touch devices disclosed herein are also inexpensive, compact and consume low power, allowing them to be easily incorporated into a wide variety of portable and desktop computers and electronic devices.

These and other advantages will become apparent to those skilled in the art upon a reading of the following specification and a study of the several figures of the drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a haptic touchpad;

FIG. **2** is a perspective view of a remote control device including the touchpad;

FIG. **3** is a perspective view of a first embodiment of the touchpad including one or more actuators coupled to the underside of the touchpad;

FIG. **4** is a side elevational view of a first embodiment in which a piezo-electric actuator is directly coupled to the touchpad;

FIG. **5** is a side elevational view of a second embodiment of the touchpad including a linear actuator;

FIG. **6** is a side elevational view of a third embodiment of the touchpad having an inertial mass;

FIG. **7** is a top plan view of an example of a touchpad having different control regions; and

FIGS. **8***a* and **8***b* are top plan and side cross sectional views, respectively, of a touch screen embodiment.

DETAILED DESCRIPTION

FIG. **1** is a perspective view of a portable computer **10** including a haptic touchpad. Computer **10** is preferably a portable or "laptop" computer that can be carried or otherwise transported by the user and may be powered by batteries or other portable energy source in addition to other more stationary power sources. Computer **10** preferably runs one or more host application programs with which a user is interacting via peripherals.

Computer **10** may include the various input and output devices as shown, including a display device **12** for outputting graphical images to the user, a keyboard **14** for providing character or toggle input from the user to the computer, and a touchpad **16**. Display device **12** can be any of a variety of types of display devices; flat-panel displays are most common on portable computers. Display device **12** can display a graphical environment **18** based on application programs and/or operating systems that are running, such as a graphical user interface (GUI), that can include a cursor **20** that can be moved by user input, as well as windows **22**, icons **24**, and other graphical objects well known in GUI environments. Other devices may also be incorporated or coupled to the computer **10**, such as storage devices (hard disk drive, DVD-ROM drive, etc.), network server or clients, game controllers, etc. In alternate embodiments, the computer **10** can take a wide variety of forms, including computing devices that rest on a tabletop or other surface, stand-up arcade game machines, other portable devices or devices worn on the person, handheld or used with a single hand of the user, etc. For example, host computer **10** can be a video game console, personal computer, workstation, a television "set top box" or a "network computer", or other computing or electronic device.

Touchpad device **16** preferably appears externally to be similar to the touchpads of the prior art. Pad **16** includes a planar, rectangular smooth surface that can be positioned below the keyboard **14** on the housing of the computer **10**, as

shown, or may be positioned at other areas of the housing. When the user operates the computer **10**, the user may conveniently place a fingertip or other object on the touchpad **16** and move the fingertip to correspondingly move cursor **20** in the graphical environment **18**.

In operation, the touchpad **16** inputs coordinate data to the main microprocessor(s) of the computer **10** based on the sensed location of an object on (or near) the touchpad. As with many touchpads of the prior art, touchpad **16** can be capacitive, resistive, or use a different type of sensing. Some existing touchpad embodiments are disclosed, for example, in U.S. Pat. Nos. 5,521,336 and 5,943,044. Capacitive touchpads typically sense the location of an object on or near the surface of the touchpad based on capacitive coupling between capacitors in the touchpad and the object. Resistive touchpads are typically pressure-sensitive, detecting the pressure of a finger, stylus, or other object against the pad, where the pressure causes conductive layers, traces, switches, etc. in the pad to electrically connect. Some resistive or other types of touchpads can detect the amount of pressure applied by the user and can use the degree of pressure for proportional or variable input to the computer **10**. Resistive touchpads typically are at least partially deformable, so that when a pressure is applied to a particular location, the conductors at that location are brought into electrical contact. Such deformability can be useful since it can potentially amplify the magnitude of output forces such as pulses or vibrations on the touchpad. Forces can be amplified if a tuned compliant suspension is provided between an actuator and the object that is moved, as described in U.S. Pat. No. 6,680,729. Capacitive touchpads and other types of touchpads that do not require significant contact pressure may be better suited in many embodiments, since excessive pressure on the touchpad may in some cases interfere with the motion of the touchpad for haptic feedback. Other types of sensing technologies can also be used in the touchpad. Herein, the term "touchpad" preferably includes the surface of the touchpad **16** as well as any sensing apparatus included in the touchpad unit.

Touchpad **16** preferably operates similarly to existing touchpads, where the speed of the fingertip on the touchpad correlates to the distance that the cursor is moved in the graphical environment. For example, if the user moves his or her finger quickly across the pad, the cursor is moved a greater distance than if the user moves the fingertip more slowly. If the user's finger reaches the edge of the touchpad before the cursor reaches a desired destination in that direction, then the user can simply move his or her finger off the touchpad, reposition the finger away from the edge, and continue moving the cursor. This is an "indexing" function similar to lifting a mouse off a surface to change the offset between mouse position and cursor. Furthermore, many touchpads can be provided with particular regions that are each assigned to particular functions that can be unrelated to cursor positioning. Such an embodiment is described in greater detail below with respect to FIG. **7**. In some embodiments the touchpad **16** may also allow a user to "tap" the touchpad (rapidly touch and remove the object from the pad) in a particular location to provide a command. For example, the user can tap or "double tap" the pad with a finger while the controlled cursor is over an icon to select that icon.

The touchpad **16** is provided with the ability to output haptic feedback such as tactile sensations to the user who is physically contacting the touchpad **16**. Various embodiments detailing the structure of the haptic feedback touchpad are described in greater detail below. Preferably, the forces output on the touchpad are linear (or approximately linear) and oriented along the z-axis, approximately perpendicular to the

surface of the touchpad **16** and the top surface of computer **10**. In a different embodiment, forces can be applied to the touchpad **16** to cause side-to-side (e.g., x-y) motion of the pad in the plane of its surface in addition to or instead of z-axis motion, although such motion is not preferred.

Using one or more actuators coupled to the touchpad **16**, a variety of haptic sensations can be output to the user who is contacting the pad. For example, jolts, vibrations (varying or constant amplitude), and textures can be output. Forces output on the pad can be at least in part based on the location of the finger on the pad or the state of a controlled object in the graphical environment of the host computer **10**, and/or independent of finger position or object state. Such forces output on the touchpad **16** are considered "computer-controlled" since a microprocessor or other electronic controller is controlling the magnitude and/or direction of the force output of the actuator(s) using electronic signals. Preferably, the entire pad **16** is provided with haptic sensations as a single unitary member; in other embodiments, individually-moving portions of the pad can each be provided with its own haptic feedback actuator and related transmissions so that haptic sensations can be provided for only a particular portion. For example, some embodiments may include a touchpad having different portions that may be flexed or otherwise moved with respect to other portions of the pad.

In other embodiments, the touchpad **16** can be provided in a separate housing that is connected to a port of the computer **10** via a cable or via wireless transmission and which receives force information from and sends position information to the computer **10**. For example, Universal Serial Bus (USB), Firewire, or a standard serial bus can connect such a touchpad to the computer **10**. In such an embodiment, the computer **10** can be any desktop or stationary computer or device and need not be a portable device.

One or more buttons **26** can also be provided on the housing of the computer **10** to be used in conjunction with the touchpad **16**. The user's hands have easy access to the buttons, each of which may be pressed by the user to provide a distinct input signal to the host computer **12**. Typically, each button **26** corresponds to a similar button found on a mouse input device, so that a left button can be used to select a graphical object (click or double click), a right button can bring up a context menu, etc. In some embodiments, one or more of the buttons **26** can be provided with tactile feedback as described in U.S. Pat. Nos. 6,184,868 and 6,563,487. Other features of these disclosures may also be used.

Furthermore, in some embodiments, one or more moveable portions **28** of the housing of the computer device **10** can be included which is contacted by the user when the user operates the touchpad **16** and which can provide haptic feedback. Having a moveable portion of a housing for haptic feedback is described in U.S. Pat. Nos. 6,184,868 and 6,088,019. Thus, both the housing can provide haptic feedback (e.g., through the use of an eccentric rotating mass on a motor coupled to the housing) and the touchpad **16** can provide separate haptic feedback. This allows the host to control two different tactile sensations simultaneously to the user, for example, a vibration of a low frequency can be conveyed through the housing to the user and a higher frequency vibration can be conveyed to the user through the touchpad **16**. Each other button or other control provided with haptic feedback can also provide tactile feedback independently from the other controls.

The host application program(s) and/or operating system preferably displays graphical images of the environment on display device **12**. The software and environment running on the host computer **12** may be of a wide variety. For example, the host application program can be a word processor, spreadsheet, video or computer game, drawing program, operating system, graphical user interface, simulation, Web page or browser that implements HTML or VRML instructions, scientific analysis program, virtual reality training program or application, or other application program that utilizes input from the touchpad **16** and outputs force feedback commands to the touchpad **16**. For example, many games and other application programs include force feedback functionality and may communicate with the touchpad **16** using a standard protocol/drivers such as I-Force®, FEELit®, or Touchsense™ available from Immersion Corporation of San Jose, Calif.

The touchpad **16** can include circuitry necessary to report control signals to the microprocessor of the host computer **10** and to process command signals from the host's microprocessor. For example, appropriate sensors (and related circuitry) are used to report the position of the user's finger on the touchpad **16**. The touchpad device also includes circuitry that receives signals from the host and outputs tactile sensations in accordance with the host signals using one or more actuators. In some embodiments, a separate, local microprocessor can be provided for the touchpad **16** to both report touchpad sensor data to the host and/or to carry out force commands received from the host, such commands including, for example, the type of haptic sensation and parameters describing the commanded haptic sensation. Alternatively, the touchpad microprocessor can simply pass streamed data from the main processor to the actuators. The term "force information" can include both commands/parameters and streamed data. The touchpad microprocessor can implement haptic sensations independently after receiving a host command by controlling the touchpad actuators; or, the host processor can maintain a greater degree of control over the haptic sensations by controlling the actuators more directly. In other embodiments, logic circuitry such as state machines provided for the touchpad **16** can handle haptic sensations as directed by the host main processor. Architectures and control methods that can be used for reading sensor signals and providing haptic feedback for a device are described in greater detail in U.S. Pat. No. 5,734,373 and co-pending application Nos. 60/156,354, 60,133,208, 09/376,649, U.S. Pat. No. 6,639,581 and 60/160,401.

FIG. **2** is a perspective view of another embodiment of a device which can include the active touchpad **16**. The device can be a handheld remote control device **30**, which the user grasps in one hand and manipulates controls to access the functions of an electronic device or appliance remotely by a user (such as a television, video cassette recorder or DVD player, audio/video receiver, Internet or network computer connected to a television, etc.). For example, several buttons **32** can be included on the remote control device **30** to manipulate functions of the controlled apparatus. A touchpad **16** can also be provided to allow the user to provide more sophisticated directional input. For example, a controlled apparatus may have a selection screen in which a cursor may be moved, and the touchpad **16** can be manipulated to control the cursor in two dimensions. The touchpad **16** includes the ability to output haptic sensations to the user as described herein, based on a controlled value or event. For example, a volume level passing a mid-point or reaching a maximum level can cause a pulse to be output to the touchpad and to the user.

In one application, the controlled apparatus can be a computer system such as Web-TV from Microsoft Corp. or other computing device which displays a graphical user interface and/or web pages accessed over a network such as the Internet. The user can control the direction of the cursor by moving

a finger (or other object) on the touchpad **16**. The cursor can be used to select and/or manipulate icons, windows, menu items, graphical buttons, slider bars, scroll bars, or other graphical objects in a graphical user interface or desktop interface. The cursor can also be used to select and/or manipulate graphical objects on a web page, such as links, images, buttons, etc. Other force sensations associated with graphical objects are described below with reference to FIG. **7**.

FIG. **3** is a perspective view of a first embodiment **40** of a touchpad **16** for providing haptic feedback to the user. In this embodiment, one or more piezoelectric actuators **42** are coupled to the underside of the touchpad **16**. The piezoelectric actuator **42** is driven by suitable electronics, as is well known to those skilled in the art. In one embodiment, a single piezoelectric actuator **42** is positioned at or near the center of the touchpad **16**, or off to one side if space constraints of the housing require such a position. In other embodiments, multiple piezoelectric actuators **42** can be positioned at different areas of the touchpad; the dashed lines show one configuration, where an actuator **42** is placed at each corner of the pad **16** and at the center of the pad.

The piezoelectric actuators **42** can each output a small pulse, vibration, or texture sensation on the touchpad **16** and to the user if the user is contacting the touchpad. The entire touchpad **16** is preferably moved with the forces output by actuator(s) **42**. Preferably, the forces output on the touchpad are linear (or approximately linear) and along the z-axis, approximately perpendicular to the surface of the touchpad **16** and the top surface of computer **10**. In a different embodiment, as mentioned above, forces can be applied to the touchpad **16** to cause side-to-side (e.g., x-y) motion of the pad in the plane of its surface in addition to or instead of z-axis motion. For example, one linear actuator can provide motion for the x-axis, and a second linear actuator can provide motion for the y-axis and/or the x-axis.

The frequency of a vibration output by an actuator **42** can be varied by providing different control signals to an actuator **42**. Furthermore, the magnitude of a pulse or vibration can be controlled based on the applied control signal. If multiple actuators **42** are provided, a stronger vibration can be imparted on the touchpad by activating two or more actuators simultaneously. Furthermore, if an actuator is positioned at an extreme end of the touchpad and is the only actuator that is activated, the user may experience a stronger vibration on the side of the touchpad having the actuator than on the opposite side of the touchpad. Different magnitudes and localized effects can be obtained by activating some but not all of the actuators. Since the tip of a user's finger that is touching the pad is fairly sensitive, the output forces do not have to be of a high magnitude for the haptic sensation to be effective and compelling.

Besides using a finger to contact the touchpad, the user may also hold other objects that directly contact the touchpad. Any haptic sensations output on the pad can be transmitted through the held object to the user's hand. For example, the user can hold a stylus having a point that contacts the touchpad **16** more precisely than a finger. Other objects may also be used. In some embodiments, specialized objects can be used to enhance the haptic sensations. For example, a stylus or other object having a flexible portion or compliance may be able to magnify at least some of the touchpad haptic sensations as experienced by the user.

The piezoelectric actuators **42** have several advantages for the touchpad **16**. These actuators can be made very thin and small, allowing their use in compact housings that are typical for portable electronic devices. They also require very low power, and are thus suitable for devices with limited power (e.g., powered by batteries). In some embodiments described herein, power for the actuators can be drawn off a bus connecting the computer to the touchpad (or touch screen). For example, if the touchpad **16** is provided in a separate housing, a Universal Serial Bus can connect the pad to the computer and provide power from the computer to the pad as well as data (e.g. streaming force data, force commands, etc.).

FIG. **4** is a side elevational view of the embodiment **40** of the touchpad **16** as shown in FIG. **3**. Touchpad **16** is directly coupled to a grounded piezo-electric actuator **42** which operates to produce a force on the touchpad **16** when an electrical signal is input to the actuator. Typically, a piezo-electric actuator includes two layers which can move relative to each other when a current is applied to the actuator; here, the grounded portion of the actuator remains stationary with respect to the surrounding housing **41** while the moving portion of the actuator and the touchpad move with respect to the housing **41**. The operation of piezo-electric actuators to output force based on an input electrical signal is well known to those skilled the art.

The touchpad **16** can be coupled only to the actuator **42**, or can be additionally coupled to the housing of the computer device at other locations besides the actuators **42**. Preferably the other couplings are compliant connections, using a material or element such as a spring or foam. If such connections are not made compliant, then the touchpad **16** itself preferably has some compliance to allow portions of the pad to move in response to actuator forces and to convey the haptic sensations to the user more effectively.

Since the touchpad **16** is directly coupled to the actuator **42**, any produced forces are directly applied to the touchpad **16**. The electric signal preferably is obtained from a microprocessor and any circuitry required to convert the microprocessor signal to an appropriate signal for use with the actuator **42**.

FIG. **5** is a side elevational view of another embodiment **50**, in which the touchpad **16** is positioned on one or more springs **52**. The springs **52** couple the touchpad **16** to the rigid housing of the computer **10** and allow the touchpad **16** to be moved along the z-axis **56**. Only a very small range of motion is required to produce effective pulses (jolts) or vibrations on the pad **16**. Stops (not shown) can be positioned to limit the travel of the touchpad **16** to a desired range along the z-axis.

An actuator **54** is also coupled to the touchpad **16** to impart forces on the touchpad and cause the touchpad **16** to move along the z-axis. In the present embodiment, actuator **54** is a linear voice coil actuator, where the moving portion (bobbin) of the actuator is directly coupled to the touchpad **16**. The actuator **54** is grounded to the computer **10** housing and outputs a linear force on the touchpad **16** and thus drives the touchpad along the z-axis. A short pulse or jolt can be output, or the moving portion of the actuator can be oscillated to provide a vibration having a particular desired frequency. The springs **52** cause the touchpad **16** to return to a rest position after a force from the actuator causes the touchpad to move up or down. The springs can also provide a compliant suspension for the touchpad **16** and allow forces output by the actuator **54** to be amplified as explained above. Different types of spring elements can be used in other embodiments to couple the touchpad **16** to the rigid housing, such as leaf springs, foam, flexures, or other compliant materials.

In some embodiments, the user is able to push the touchpad **16** along the z-axis to provide additional input to the computer **10**. For example, a sensor can be used to detect the position of the touchpad **16** along the z-axis, such as an optical sensor, magnetic sensor, Polhemus sensor, etc. The position on the z-axis can be used to provide proportional input to the computer, for example. In addition, other types of forces can be

output along the z-axis, such as spring forces, damping forces, inertial forces, and other position-based forces, as disclosed in U.S. Pat. No. 6,563,487. In addition, 3-D elevations can be simulated in the graphical environment by moving the pad to different elevations along the z-axis. If the pad **16** can be used as an analog input depending on the distance the entire pad is moved along the z-axis, and/or if kinesthetic (force) feedback is applied in the z-axis degree of freedom, then a greater range of motion for the pad **16** along the z-axis is desirable. An elastomeric layer can be provided if the touchpad **16** is able to be pressed by the user to close a switch and provide button or switch input to the computer **10** (e.g. using contact switches, optical switches, or the like). If such z-axis movement of the pad **16** is allowed, it is preferred that the z-axis movement require a relatively large amount of force to move the pad at least initially, since such z-axis movement may not be desired during normal use of the pad by the user.

The voice coil actuator **54** preferably includes a coil and a magnet, where a current is flowed through the coil and interacts with the magnetic field of the magnet to cause a force on the moving portion of the actuator (the coil or the magnet, depending on the implementation), as is well known to those skilled in the art and is described in U.S. Pat. No. 6,184,868. Other types of actuators can also be used, such as a standard speaker, an E-core type actuator (as described in U.S. Pat. No. 6,704,001), a solenoid, a pager motor, a DC motor, moving magnet actuator (described in provisional application No. 60/133,208 and U.S. Pat. No. 6,704,001), or other type of actuator. Furthermore, the actuator can be positioned to output linear motion along an axis perpendicular to the z-axis or along another direction different from the z-axis (rotary or linear), where a mechanism converts such output motion to linear motion along the z-axis as is well known to those skilled in the art.

The touchpad **16** can also be integrated with an elastomeric layer and/or a printed circuit board in a sub-assembly, where one or more actuators are coupled to the printed circuit board to provide tactile sensations to the touchpad **16**. Helical springs can also be provided to engage electrical contacts. Or, multiple voice coil actuators can be positioned at different locations under the touchpad **16**. These embodiments are described in U.S. Pat. No. 6,563,487. Any of the actuators described in that patent can also be used.

FIG. **6** is a side elevational view of a third embodiment **60** of the haptic touchpad **16**. In this embodiment, the stationary portion of the actuator is coupled to the touchpad **16**, and the moving portion of the actuator is coupled to an inertial mass to provide inertial haptic sensations.

Touchpad **16** can be compliantly mounted to the rigid housing of the computer device similarly to the embodiments described above. For example, one or more spring elements **62** can be coupled between the touchpad and the housing. These springs can be helical or leaf springs, a compliant material such as rubber or foam, flexures, etc.

One or more actuators **64** are coupled to the underside of the touchpad **16**. In the embodiment of FIG. **6**, a piezoelectric actuator is shown. One portion **66** of each actuator **64** is coupled to the touchpad **16**, and the other portion **68** is coupled to a mass **70**. Thus, when the portion **68** is moved relative to the portion **66**, the mass **70** is moved with the portion **68**. The mass **70** can be any suitable object of the desired weight, such as plastic or metal material. The mass **70** is moved approximately along the z-axis and is not coupled to the housing, allowing free motion. The motion of the mass **70** along the z-axis causes an inertial force that is transmitted through the actuator **64** to the touchpad **16**, and the touchpad **16** moves along the z-axis due to the compliant coupling **62**. The motion of the touchpad **16** is felt by the user contacting the touchpad **16** as a haptic sensation.

In different embodiments, other types of actuators can be used. For example, a linear voice coil actuator as described for FIG. **5** can be used, in which an inertial mass is coupled to the linear-moving portion of the voice coil actuator. Other actuators can also be used, such as solenoids, pager motors, moving magnet actuators, E-core actuators, etc. Many actuators used for inertial haptic sensations are described in U.S. Pat. No. 6,211,861. Furthermore, a rotary actuator can be used, where the rotary output force is converted to a linear force approximately along the z-axis. For example, the rotary force can be converted using a flexure, as described in U.S. Pat. No. 6,697,043.

In the preferred linear force implementation, the direction or degree of freedom that the force is applied on the touchpad with respect to the inertial mass is important. If a significant component of the force is applied in the planar workspace of the touchpad (i.e., along the X or Y axis) with respect to the inertial mass, a short pulse or vibration can interfere with the user's object motion in one or both of those planar degrees of freedom and thereby impair the user's ability to accurately guide a controlled graphical object, such as a cursor, to a given target. Since a primary function of the touchpad is accurate targeting, a tactile sensation that distorts or impairs targeting, even mildly, is undesirable. To solve this problem, the touchpad device applies inertial forces substantially along the Z axis, orthogonal to the planar X and Y axes of the touchpad surface. In such a configuration, tactile sensations can be applied at a perceptually strong level for the user without impairing the ability to accurately position a user controlled graphical object in the X and Y axes of the screen. Furthermore, since the tactile sensations are directed in a third degree of freedom relative to the two-dimensional planar workspace and display screen, jolts or pulses output along the Z axis feel much more like three-dimensional bumps or divots to the user that come "out" or go "into" the screen, increasing the realism of the tactile sensations and creating a more compelling interaction. For example, an upwardly-directed pulse that is output when the cursor is moved over a window border creates the illusion that the user is moving a finger or other object "over" a bump at the window border.

FIG. **7** is a top elevational view of the touchpad **16**. Touchpad **16** can in some embodiments be used simply as a positioning device, where the entire area of the pad provides cursor control. In other embodiments, different regions of the pad can be designated for different functions. In some of these region embodiments, each region can be provided with an actuator located under the region, while other region embodiments may use a single actuator that imparts forces on the entire pad **16**. In the embodiment shown, a central cursor control region **70** is used to position the cursor.

The cursor control region **70** of the pad **16** can cause forces to be output on the pad based on interactions of the controlled cursor with the graphical environment and/or events in that environment. The user moves a finger or other object within region **70** to correspondingly move the cursor **20**. Forces are preferably associated with the interactions of the cursor with displayed graphical objects. For example, a jolt or "pulse" sensation can be output, which is a single impulse of force that quickly rises to the desired magnitude and then is turned off or quickly decays back to zero or small magnitude. The touchpad **16** can be jolted in the z-axis to provide the pulse. A vibration sensation can also be output, which is a time-varying force that is typically periodic. The vibration can cause the touchpad **16** or portions thereof to oscillate back and forth on

the z axis, and can be output by a host or local microprocessor to simulate a particular effect that is occurring in a host application.

Another type of force sensation that can be output on the touchpad **16** is a texture force. This type of force is similar to a pulse force, but depends on the position of the user's finger on the area of the touchpad and/or on the location of the cursor in the graphical environment. Thus, texture bumps are output depending on whether the cursor has moved over a location of a bump in a graphical object. This type of force is spatially-dependent, i.e. a force is output depending on the location of the cursor as it moves over a designated textured area; when the cursor is positioned between "bumps" of the texture, no force is output, and when the cursor moves over a bump, a force is output. This can be achieved by host control (e.g., the host sends the pulse signals as the cursor is dragged over the grating). In some embodiments, a separate touchpad microprocessor can be dedicated for haptic feedback with the touchpad, and the texture effect and be achieved using local control (e.g., the host sends a high level command with texture parameters and the sensation is directly controlled by the touchpad processor). In other cases a texture can be performed by presenting a vibration to a user, the vibration being dependent upon the current velocity of the user's finger (or other object) on the touchpad. When the finger is stationary, the vibration is deactivated; as the finger is moved faster, the frequency and magnitude of the vibration is increased. This sensation can be controlled locally by the touchpad processor (if present), or be controlled by the host. Local control by the pad processor may eliminate communication burden in some embodiments. Other spatial force sensations can also be output. In addition, any of the described force sensations herein can be output simultaneously or otherwise combined as desired.

Different types of graphical objects can be associated with tactile sensations. Tactile sensations can output on the touchpad **16** based on interaction between a cursor and a window. For example, a z-axis "bump" or pulse can be output on the touchpad to signal the user of the location of the cursor when the cursor is moved over a border of a window. When the cursor is moved within the window's borders, a texture force sensation can be output. The texture can be a series of bumps that are spatially arranged within the area of the window in a predefined pattern; when the cursor moves over a designated bump area, a bump force is output on the touchpad. A pulse or bump force can be output when the cursor is moved over a selectable object, such as a link in a displayed web page or an icon. A vibration can also be output to signify a graphical object which the cursor is currently positioned over. Furthermore, features of a document displaying in a window can also be associated with force sensations. For example, a pulse can be output on the touchpad when a page break in a document is scrolled past a particular area of the window. Page breaks or line breaks in a document can similarly be associated with force sensations such as bumps or vibrations.

Furthermore, a menu items in a displayed menu can be selected by the user after a menu heading or graphical button is selected. The individual menu items in the menu can be associated with forces. For example, vertical (z-axis) bumps or pulses can be output when the cursor is moved over the border between menu items. The sensations for certain menu choices can be stronger than others to indicate importance or frequency of use, i.e., the most used menu choices can be associated with higher-magnitude (stronger) pulses than the less used menu choices. Also, currently-disabled menu choices can have a weaker pulse, or no pulse, to indicate that the menu choice is not enabled at that time. Furthermore, when providing tiled menus in which a sub-menu is displayed after a particular menu element is selected, as in Microsoft Windows™, pulse sensations can be sent when a sub-menu is displayed. This can be very useful because users may not expect a sub-menu to be displayed when moving a cursor on a menu element. Icons can be associated with textures, pulses, and vibrations similarly to the windows described above. Drawing or CAD programs also have many features which can be associated with similar haptic sensations, such as displayed (or invisible) grid lines or dots, control points of a drawn object, etc.

In other related interactions, when a rate control or scrolling function is performed with the touchpad (through use of the cursor), a vibration can be displayed on the device to indicate that scrolling is in process. When reaching the end of a numerical range that is being adjusted (such as volume), a pulse can be output to indicate that the end of the range has been reached. Pulse sensations can be used to indicate the location of the "ticks" for discrete values or settings in the adjusted range. A pulse can also be output to inform the user when the center of the range is reached. Different strength pulses can also be used, larger strength indicating the more important ticks. In other instances, strength and/or frequency of a vibration can be correlated with the adjustment of a control to indicate current magnitude of the volume or other adjusted value. In other interactions, a vibration sensation can be used to indicate that a control function is active. Furthermore, in some cases a user performs a function, like selection or cutting or pasting a document, and there is a delay between the button press that commands the function and the execution of the function, due to processing delays or other delays. A pulse sensation can be used to indicate that the function (the cut or paste) has been executed.

Furthermore, the magnitude of output forces on the touchpad can depend on the event or interaction in the graphical environment. For example, the force pulse can be a different magnitude of force depending on the type of graphical object encountered by the cursor. For example, a pulses of higher magnitude can be output when the cursor moves over windows, while pulses of lower magnitude can be output when the cursor moves over icons. The magnitude of the pulses can also depend on other characteristics of graphical objects, such as an active window as distinguished a background window, file folder icons of different priorities designated by the user, icons for games as distinguished from icons for business applications, different menu items in a drop-down menu, etc. The user or developer can also preferably associate particular graphical objects with customized haptic sensations.

User-independent events can also be relayed to the user using haptic sensations on the touchpad. An event occurring within the graphical environment, such as an appointment reminder, receipt of email, explosion in a game, etc., can be signified using a vibration, pulse, or other time-based force. The force sensation can be varied to signify different events of the same type. For example, vibrations of different frequency can each be used to differentiate different events or different characteristics of events, such as particular users sending email, the priority of an event, or the initiation or conclusion of particular tasks (e.g. the downloading of a document or data over a network). When the host system is "thinking," requiring the user to wait while a function is being performed or accessed (usually when a timer is displayed by the host) it is often a surprise when the function is complete. If the user takes his or her eyes off the screen, he or she may not be aware that the function is complete. A pulse sensation can be sent to indicate that the "thinking" is over.

A software designer may want to allow a user to be able to select options or a software function by positioning a cursor over an area on the screen using the touchpad, but not require pressing a physical button or tapping the touchpad to actually select the option. Currently, it is problematic to allow such selection because a user has physical confirmation of execution when pressing a physical button. A pulse sent to the touchpad can act as that physical confirmation without the user having to press a button or other control for selection. For example, a user can position a cursor over a web page element, and once the cursor is within the desired region for a given period of time, an associated function can be executed. This is indicated to the user through a tactile pulse sent to the pad **16**.

The above-described force sensations can also be used in games or simulations. For example, a vibration can be output when a user-controlled racing car is driving on a dirt shoulder of a displayed road, a pulse can be output when the car collides with another object, and a varying-frequency vibration can be output when a vehicle engine starts and rumbles. The magnitude of pulses can be based on the severity of a collision or explosion, the size of the controlled graphical object or entity (and/or the size of a different graphical object/entity that is interacted with), etc. Force sensations can also be output based on user-independent events in the game or simulation, such as pulses when bullets are fired at the user's character.

The above haptic sensations can be similar to those described in U.S. Pat. Nos. 6,243,078 and 6,211,861. Other control devices or grips that can include a touchpad **16** in its housing include a gamepad, mouse or trackball device for manipulating a cursor or other graphical objects in a computer-generated environment; or a pressure sphere or the like. For example, the touchpad **16** can be provided on the housing of a computer mouse to provide additional input to the host computer. Furthermore, selective disturbance filtering of forces, as described in U.S. Pat. No. 6,020,876, and shaping of force signals to drive the touchpad with impulse waves as described in U.S. Pat. No. 5,959,613, can be used. Such impulses are also effective when driven with stored power in a battery on the computer **10** or from a bus such as USB connected to a host computer.

The touchpad **16** can also be provided with different control regions that provide separate input from the main cursor control region **70**. In some embodiments, the different regions can be physically marked with lines, borders, or textures on the surface of the pad **16** (and/or sounds from the computer **10**) so that the user can visually, audibly, and/or or tactilely tell which region he or she is contacting on the pad.

For example, scroll or rate control regions **72***a* and **72***b* can be used to provide input to perform a rate control task, such as scrolling documents, adjusting a value (such as audio volume, speaker balance, monitor display brightness, etc.), or panning/tilting the view in a game or virtual reality simulation. Region **72***a* can be used by placing a finger (or other object) within the region, where the upper portion of the region will increase the value, scroll up, etc., and the lower portion of the region will decrease the value, scroll down, etc. In embodiments that can read the amount of pressure placed on the pad **16**, the amount of pressure can directly control the rate of adjustment; e.g., a greater pressure will cause a document to scroll faster. The region **72***b* can similarly be used for horizontal (left/right) scrolling or rate control adjustment of a different value, view, etc.

Particular haptic effects can be associated with the control regions **72***a* and **72***b*. For example, when using the rate control region **72***a* or **72***b*, a vibration of a particular frequency can be output on the pad **16**. In those embodiments having multiple actuators, an actuator placed directly under the region **72***a* or **72***b* can be activated to provide a more localized tactile sensation for the "active" (currently used) region. As a portion of a region **72** is pressed for rate control, pulses can be output on the pad (or region of the pad) to indicate when a page has scroll by, a particular value has passed, etc. A vibration can also be continually output while the user contacts the region **72***a* or **72***b*.

Other regions **74** can also be positioned on the touchpad **16**. For example, each of regions **74** provides a small rectangular area, like a button, which the user can point to in order to initiate a function associated with the pointed to region. The regions **74** can initiate such computer functions as running a program, opening or closing a window, going "forward" or "back" in a queue of web pages in a web browser, powering the computer **10** or initiating a "sleep" mode, checking mail, firing a gun in a game, cutting or pasting data from a buffer, selecting a font, etc. The regions **74** can duplicate functions and buttons provided in an application program or provide new, different functions.

Similarly to regions **72**, the regions **74** an each be associated with haptic sensations; for example, a region **74** can provide a pulse sensation when it has been selected by the user, providing instant feedback that the function has been selected. Furthermore, the same types of regions can be associated with similar-feeling haptic sensations. For example, each word processor related region **74** can, when pointed to, cause a pulse of a particular strength, while each game-related region can provide a pulse of different strength or a vibration. Furthermore, when the user moves the pointing object from one region **72** or **74** to another, a haptic sensation (such as a pulse) can be output on the pad **16** to signify that a region border has been crossed.

In addition, the regions are preferably programmable in size and shape as well as in the function with which they are associated. Thus, the functions for regions **64** can change based on an active application program in the graphical environment and/or based on user preferences input to and/or stored on the computer **10**. Preferably, the size and location of each of the regions can be adjusted by the user or by an application program, and any or all of the regions can be completely removed if desired. Furthermore, the user is preferably able to assign particular haptic sensations to particular areas or types of areas based on types of functions associated with those areas, as desired. Different haptic sensations can be designed in a tool such as Immersion Studio™ available from Immersion Corporation of San Jose, Calif.

It should be noted that the regions **72** and **74** need not be physical regions of the touchpad **16**. That is, the entire touchpad **16** surface need merely provide coordinates of user contact to the processor of the computer and software on the computer can designate where different regions are located. The computer can interpret the coordinates and, based on the location of the user contact, can interpret the touchpad input signal as a cursor control signal or a different type of signal, such as rate control, button function, etc. The local touchpad microprocessor, if present, may alternatively interpret the function associated with the user contact location and report appropriate signal or data to the host processor (such as position coordinates or a button signal), thus keeping the host processor ignorant of the lower level processing. In other embodiments, the touchpad **16** can be physically designed to output different signals to the computer based on different regions marked on the touchpad surface that are contacted by the user; e.g. each region can be sensed by a different sensor or sensor array.

FIGS. **8***a* and **8***b* are top plan and side cross-sectional views, respectively, of another computer device embodiment **80** including a form of the haptic touchpad **16**. Device **80** is in the form of a portable computer device such as "personal digital assistant" (PDA), a "pen-based" computer, "electronic book", or similar device (collectively known as a "personal digital assistant" or PDA herein). Those devices which allow a user to input information by touching a display screen or readout in some fashion are primarily relevant to this embodiment. Such devices can include the Palm Pilot from 3Com Corp., the Newton from Apple Computer, pocket-sized computer devices from Casio, Hewlett-Packard, or other manufacturers, cellular phones or pagers having touch screens, etc.

In one embodiment of a device **80**, a display screen **82** typically covers a large portion of the surface of the computer device **80**. Screen **82** is preferably a flat-panel display as is well known to those skilled in the art and can display text, images, animations, etc.; in some embodiments screen **80** is as functional as any personal computer screen. Display screen **82** is preferably a "touch screen" that includes sensors which allow the user to input information to the computer device **80** by physically contacting the screen **80** (i.e. it is another form of planar "touch device" similar to the touchpad **16**). For example, a transparent sensor film can be overlaid on the screen **80**, where the film can detect pressure from an object contacting the film. The sensor devices for implementing touch screens are well known to those skilled in the art.

The user can select graphically-displayed buttons or other graphical objects by pressing a finger or a stylus to the screen **82** at the exact location where the graphical object is displayed. Furthermore, some embodiments allow the user to "draw" or "write" on the screen by displaying graphical "ink" images **85** at locations where the user has pressed a tip of a stylus, finger, or other object. Handwritten characters can be recognized by software running on the device microprocessor as commands, data, or other input. In other embodiments, the user can provide input additionally or alternatively through voice recognition, where a microphone on the device inputs the user's voice which is translated to appropriate commands or data by software running on the device. Physical buttons **84** can also be included in the housing of the device **80** to provide particular commands to the device **80** when the buttons are pressed. Many PDA's are characterized by the lack of a standard keyboard for character input from the user; rather, an alternative input mode is used, such as using a stylus to draw characters on the screen, voice recognition, etc. However, some PDA's also include a fully-functional keyboard as well as a touch screen, where the keyboard is typically much smaller than a standard-sized keyboard. In yet other embodiments, standard-size laptop computers with standard keyboards may include flat-panel touch-input display screens, and such screens (similar to screen **12** of FIG. **1**) can be provided with haptic feedback.

The touch screen **82** provides haptic feedback to the user similarly to the touchpad **16** described in previous embodiments. One or more actuators **86** can be coupled to the underside of the touch screen **82** to provide haptic feedback such as pulses, vibrations, and textures; for example, an actuator **86** can be positioned near each corner of the screen **82**, as shown in FIG. **8***a*. Other configurations of actuators can also be used. The user can experience the haptic feedback through a finger or a held object such as a stylus **87** that is contacting the screen **82**.

As shown in FIG. **8***b*, the touch screen **82** is preferably coupled to the housing **88** of the device **80** by one or more spring or compliant elements **90**, such as helical springs, leaf springs, flexures, or compliant material (foam, rubber, etc.) The compliant element allows the touch screen **82** to move approximately along the z-axis, thereby providing haptic feedback similarly to the touchpad embodiments described above. Actuators **86** can be piezo-electric actuators, voice coil actuators, or any of the other types of actuators described above for the touchpad embodiments. As shown in FIG. **8***b*, the actuators **86** are directly coupled to the touch screen **82** similarly to the touchpad embodiment of FIG. **3**; alternatively, an inertial mass can be moved to provide inertial feedback in the z-axis of the touch screen, similarly to the touchpad embodiment of FIG. **6**. Other features described above for the touchpad are equally applicable to the touch screen embodiment **80**.

In the embodiments of touch input devices (touchpad and touch screen) described herein, it is also advantageous that contact of the user is detected by the touch input device. Since haptic feedback need only be output when the user is contacting the touch device, this detection allows haptic feedback to be stopped (actuators "turned off") when no objects are contacting the touch input device. This feature can conserve battery power for portable devices. If a local touch device microprocessor (or similar circuitry) is being used in the computer, such a microprocessor can turn off actuator output when no user contact is sensed, thus alleviating the host processor of additional computational burden.

While the subject matter has been described in terms of several preferred embodiments, it is contemplated that alterations, permutations, and equivalents thereof will become apparent to those skilled in the art upon a reading of the specification and study of the drawings. For example, many different types of actuators can be used to output tactile sensations to the user. Furthermore, many of the features described in one embodiment can be used interchangeably with other embodiments. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to be limiting.

What is claimed is:

1. A haptic feedback device, comprising:

a touch screen operative to display a graphical image and to output a position signal indicative of a selected location on the touch screen in two dimensions; and

at least a first actuator configured to impart a first force directly to the touch screen to thereby provide a haptic effect in response to the selection, the first force based on information output by a computer device wherein at least the first force is output substantially parallel to a plane of the touch screen.

2. The haptic feedback device of claim **1**, further comprising a housing, wherein the first actuator is a linear actuator configured to provide an output force in a linear degree of freedom, wherein the first actuator is rigidly coupled to the housing.

3. The haptic feedback device of claim **1**, wherein the first actuator is a rotary actuator configured to provide an output force in a rotary degree of freedom, the output force being converted to the linear force on the touch screen.

4. The haptic feedback device of claim **1**, wherein the first actuator is an inertial actuator that provides an inertial force on the touch screen.

5. The haptic feedback device of claim **1**, further comprising a sensor configured to send to the computer device a signal indicative of at least one chosen from the group consisting of a motion, a pressure and a position of the selection.

6. The haptic feedback device of claim **5**, wherein the motion is a velocity or a change in velocity.

7. A haptic feedback device, comprising:

a touch screen operative to display a graphical image and to output a position signal indicative of a selected location on the touch screen in two dimensions; and

at least a first actuator configured to impart a first force directly to the touch screen to thereby provide a haptic effect in response to the selection, the first force based on information output by a computer device, wherein the touch screen is operative to allow the user to draw or write on the touch screen resulting in a graphical display at locations where the user has pressed a tip of an object.

8. The haptic feedback device of claim **7**, wherein the object is a stylus or a finger.

9. The haptic feedback device of claim **8**, wherein the first region provides the position signal and the second region provides a second signal.

10. The haptic feedback device of claim **8**, wherein the second signal is used in a rate control function of a value.

11. The haptic feedback device of claim **8**, wherein the second signal is used in conjunction with a button press.

12. The haptic feedback device of claim **8**, wherein the first region is capable of outputting a haptic sensation that is different from a haptic sensation output at the second region.

13. The haptic feedback device of claim **8**, wherein the computer device is configured to send a control signal to the first actuator when the select changes from one of the first and second regions to the other of the first and second regions.

14. A haptic feedback device, comprising:

a touch screen operative to display a graphical image and to output a position signal indicative of a selected location on the touch screen in two dimensions; and

at least a first actuator configured to impart a first force directly to the touch screen to thereby provide a haptic effect in response to the selection, the first force based on information output by a computer device, wherein the first actuator is capable of outputting a continuous vibration or a pulse tactile sensation on the touch screen.

15. A haptic feedback device, comprising:

a touch screen operative to display a graphical image and to output a position signal indicative of a selected location on the touch screen in two dimensions; and

at least a first actuator configured to impart a first force directly to the touch screen to thereby provide a haptic effect in response to the selection, the first force based on information output by a computer device wherein the touch screen includes a first region and a second region.

16. A haptic feedback device, comprising:

a touch screen including a first region and a second region, the touch screen being operative to display a graphical image and to output a position signal indicative of a selected location on the touch screen in two dimensions; and

at least a first actuator configured to impart a first force directly to the touch screen to thereby provide a haptic effect in response to the selection, the first force based on information output by a computer device configured to send a control signal to at least one actuator when the select position changes from one of the first and second regions to the other of the first and second regions.

17. A haptic feedback device, comprising:

a touch input device configured to receive user input and generate an input signal in response to the user input;

one or more processors configured to receive the input signal, generate a force signal based on the input signal, and generate a graphical environment;

a display configured to display the graphical environment, wherein the input signal is associated with an interaction by the user with the graphical environment; and

one or more actuators configured to receive the force signal and impart a haptic effect based on the force signal,

wherein the graphical environment comprises a menu presented at the display, wherein the menu comprises one or more menu items, and wherein the user input comprises navigation between the one or more menu items,

wherein the one or more menu items comprise a first menu item and a second menu item, wherein the first menu item is associated with a first haptic effect and the second menu item is associated with a second haptic effect different from the first haptic effect.

18. A haptic feedback device, comprising:

a touch input device configured to receive user input and generate an input signal in response to the user input;

one or more processors configured to receive the input signal, generate a force signal based on the input signal, and generate a graphical environment;

a display configured to display the graphical environment, wherein the input signal is associated with an interaction by the user with the graphical environment; and

one or more actuators configured to receive the force signal and impart a haptic effect based on the force signal,

wherein the graphical environment comprises a menu presented at the display, wherein the menu comprises one or more menu items, and wherein the user input comprises navigation between the one or more menu items,

wherein at least one of the one or more menu items is associated with a sub-menu, wherein the actuator is configured to impart the haptic effect when the sub-menu is displayed.

19. A haptic feedback device, comprising:

one or more processors configured to receive an input signal and generate a force signal based on the input signal,

wherein the input signal is associated with a user-independent event,

the user-independent event comprising one or more of a reminder event, an initiation of a task, a processing of the task, a conclusion of the task, a receipt of an email, or an event occurring in a game; and

one or more actuators configured to receive the force signal and impart a haptic effect based on the force signal.

20. The haptic feedback device of claim **19**, wherein the haptic feedback device comprises a portable computing device, a PDA, a pager, or a cellular phone.

21. The haptic feedback device of claim **19**, wherein the touch input device comprises a touch screen, a touch pad, or a keypad.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,059,105 B2
APPLICATION NO. : 12/008916
DATED : November 15, 2011
INVENTOR(S) : Rosenberg et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Col. 18, Claim 21, line 2: replace "touch input" with --haptic feedback--

Signed and Sealed this
First Day of May, 2012

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,059,105 B2
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DATED : November 15, 2011
INVENTOR(S) : Rosenberg et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 18, line 58 (Claim 21, line 2) replace “touch input” with --haptic feedback--

This certificate supersedes the Certificate of Correction issued May 1, 2012.

Signed and Sealed this
Twenty-ninth Day of May, 2012

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

US008031181B2

(12) **United States Patent**
Rosenberg et al.

(10) **Patent No.: US 8,031,181 B2**
(45) **Date of Patent: Oct. 4, 2011**

(54) **HAPTIC FEEDBACK FOR TOUCHPADS AND OTHER TOUCH CONTROLS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 805 days.

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(63) Continuation of application No. 11/405,811, filed on Apr. 17, 2006, now Pat. No. 7,592,999, which is a continuation of application No. 10/213,940, filed on Aug. 6, 2002, now Pat. No. 7,148,875, which is a continuation of application No. 09/487,737, filed on Jan. 19, 2000, now Pat. No. 6,429,846, which is a continuation-in-part of application No. 09/467,309, filed on Dec. 17, 1999, now Pat. No. 6,563,487, which is a continuation-in-part of application No. 09/253,132, filed on Feb. 18, 1999, now Pat. No. 6,243,078, which is a continuation-in-part of application No. 09/156,802, filed on Sep. 17, 1998, now Pat. No. 6,184,868, which is a continuation-in-part of application No. 09/103,281, filed on Jun. 23, 1998, now Pat. No. 6,088,019.

(51) **Int. Cl.**
G09G 5/00 (2006.01)

(52) **U.S. Cl.** **345/173**; 178/18.01; 463/30

(58) **Field of Classification Search** 345/156, 345/173–183; 178/18.01, 19.01; 715/701–702; 463/30, 36–38
See application file for complete search history.

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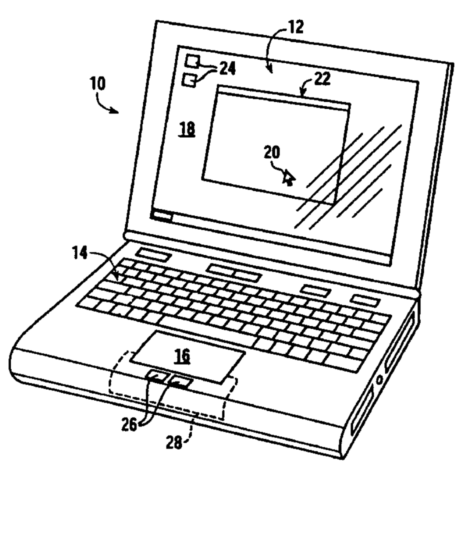
(57) **ABSTRACT**

A haptic feedback planar touch control used to provide input to a computer. A touch input device includes a planar touch surface that inputs a position signal to a processor of the computer based on a location of user contact on the touch surface. The computer can position a cursor in a displayed graphical environment based at least in part on the position signal, or perform a different function. At least one actuator is also coupled to the touch input device and outputs a force to provide a haptic sensation to the user contacting the touch surface. The touch input device can be a touchpad separate from the computer's display screen, or can be a touch screen. Output haptic sensations on the touch input device can include pulses, vibrations, and spatial textures. The touch input device can include multiple different regions to control different computer functions.

35 Claims, 5 Drawing Sheets



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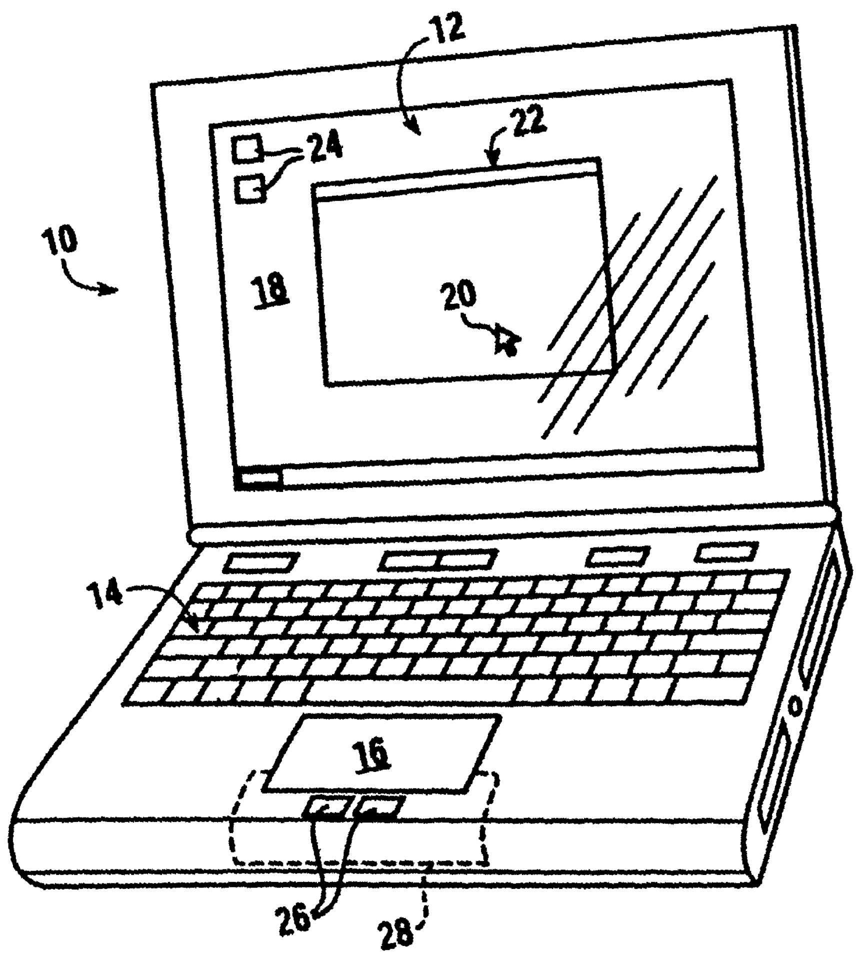

FIG. 1

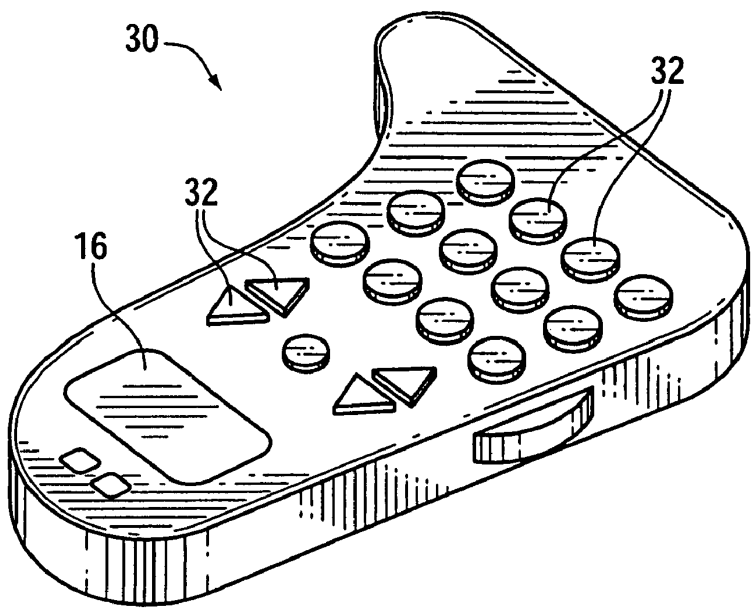

FIG. 2

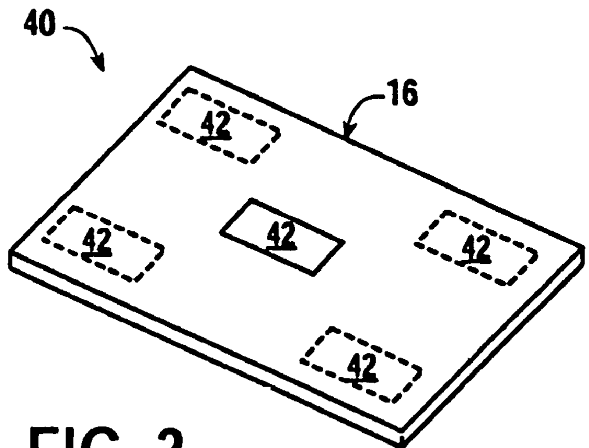

FIG. 3

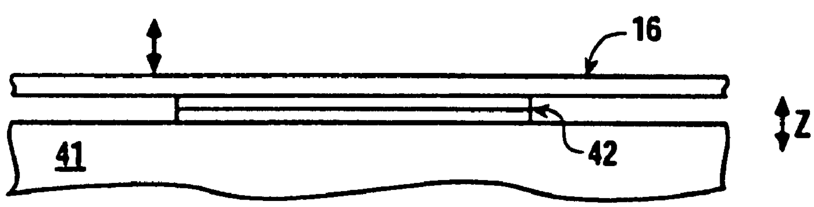

FIG. 4

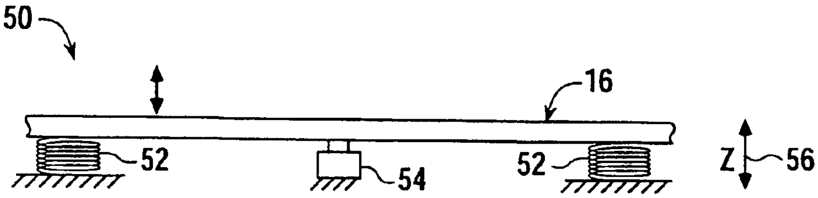

FIG. 5

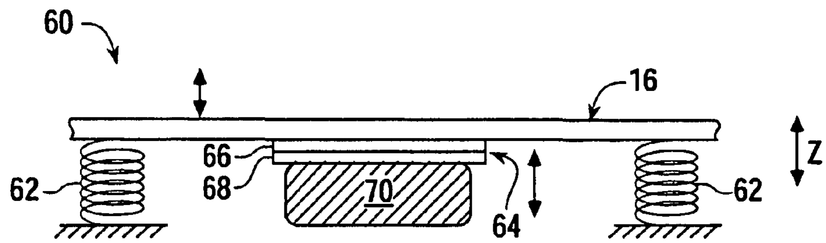

FIG. 6

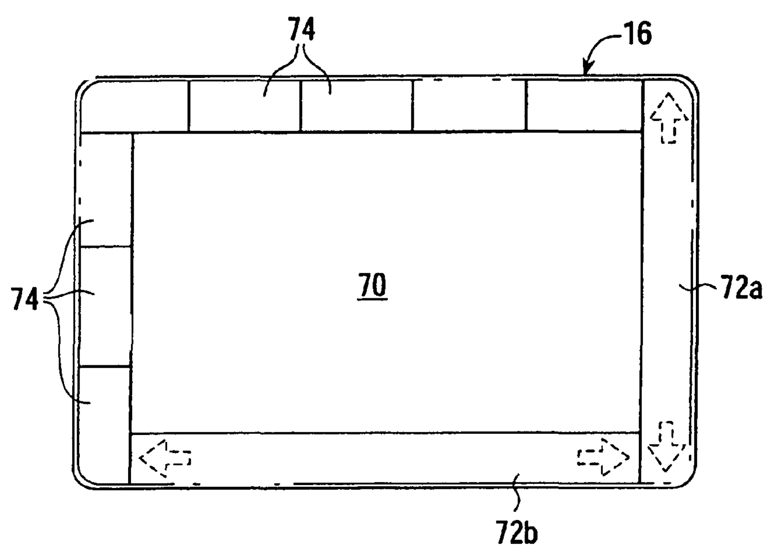

FIG. 7

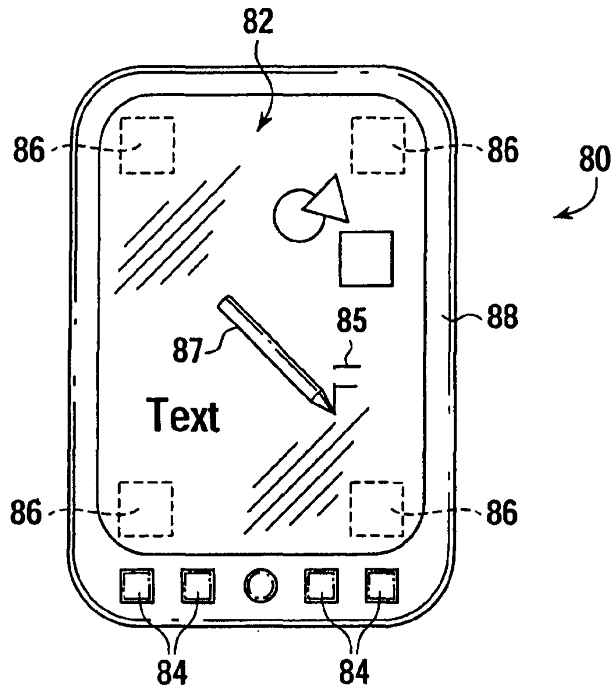

FIG. 8A

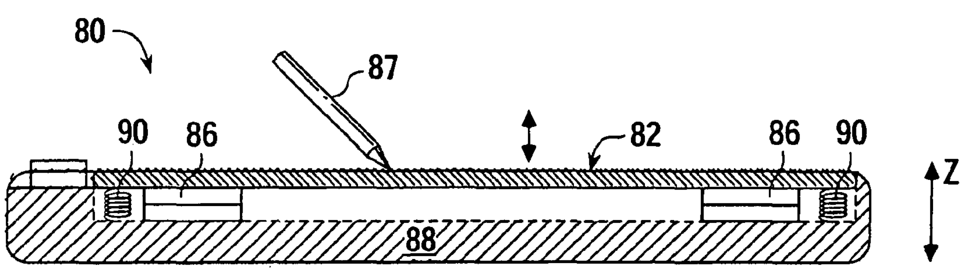

FIG. 8B

HAPTIC FEEDBACK FOR TOUCHPADS AND OTHER TOUCH CONTROLS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 11/405,811 entitled "Haptic Feedback for Touchpads and Other Touch Controls," filed Apr. 17, 2006, which is a continuation of U.S. Pat. No. 7,148,875, entitled "Haptic Feedback for Touchpads and Other Touch Controls," issued Dec. 12, 2006, which is a continuation of U.S. Pat. No. 6,429,846, entitled "Haptic Feedback for Touchpads and Other Touch Controls," issued Aug. 6, 2002, which is a continuation-in-part of U.S. Pat. No. 6,563,487, entitled "Haptic Feedback for Directional Control Pads," issued May 13, 2003, which is a continuation-in-part of U.S. Pat. No. 6,243, 078, entitled "Low Cost Force Feedback Pointing Device," issued Jun. 5, 2001, which is a continuation-in-part of U.S. Pat. No. 6,184,868, entitled "Haptic Feedback Control Devices," issued Feb. 6, 2001, which is a continuation-in-part of U.S. Pat. No. 6,088,019, entitled "Low Cost Force Feedback Device with Actuator for Non-Primary Axis," issued Jul. 11, 2000.

BACKGROUND

The subject matter described relates generally to the interfacing with computer and mechanical devices by a user, and more particularly to devices used to interface with computer systems and electronic devices and which provide haptic feedback to the user.

Humans interface with electronic and mechanical devices in a variety of applications, and the need for a more natural, easy-to-use, and informative interface is a constant concern. In the context, humans interface with computer devices for a variety of applications. One such application is interacting with computer-generated environments such as games, simulations, and application programs. Computer input devices such as mice and trackballs are often used to control a cursor within a graphical environment and provide input in these applications.

In some interface devices, force feedback or tactile feedback is also provided to the user, collectively known herein as "haptic feedback." For example, haptic versions of joysticks, mice, gamepads, steering wheels, or other types of devices can output forces to the user based on events or interactions occurring within the graphical environment, such as in a game or other application program.

In portable computer or electronic devices, such as laptop computers, mice typically too large a workspace to be practical. As a result, more compact devices such as trackballs are often used. A more popular device for portable computers are "touchpads," which are small rectangular, planar pads provided near the keyboard of the computer. The touchpads senses the location of a pointing object by any of a variety of sensing technologies, such as capacitive sensors or pressure sensors that detect pressure applied to the touchpad. The user contacts the touchpad most commonly with a fingertip and moves his or her finger on the pad to move a cursor displayed in the graphical environment. In other embodiments, the user can operate a stylus in conjunction with the touchpad by pressing the stylus tip on the touchpad and moving the stylus.

One problem with existing touchpads is that there is no haptic feedback provided to the user. The user of a touchpad is therefore not able to experience haptic sensations that assist and inform the user of targeting and other control tasks within the graphical environment. The touchpads of the prior art also cannot take advantage of existing haptic-enabled software run on the portable computer.

OVERVIEW

An embodiment is directed to a haptic feedback planar touch control used to provide input to a computer system. The control can be a touchpad provided on a portable computer, or can be a touch screen found on a variety of devices. The haptic sensations output on the touch control enhance interactions and manipulations in a displayed graphical environment or when controlling an electronic device.

More specifically, the embodiment relates to a haptic feedback touch control for inputting signals to a computer and for outputting forces to a user of the touch control. The control includes a touch input device including an approximately planar touch surface operative to input a position signal to a processor of said computer based on a location of user contact on the touch surface. The computer positions a cursor in a graphical environment displayed on a display device based at least in part on the position signal. At least one actuator is also coupled to the touch input device and outputs a force on the touch input device to provide a haptic sensation to the user contacting the touch surface. The actuator outputs the force based on force information output by the processor to the actuator.

The touch input device can be a touchpad separate from a display screen of the computer, or can be included in a display screen of the computer as a touch screen. The touch input device can be integrated in a housing of the computer or handheld device, or provided in a housing that is separate from the computer. The user contacts the touch surface with a finger, a stylus, or other object. The force is preferably a linear force output approximately perpendicularly to a plane of the touch surface of the touch input device, and the actuator can include a piezo-electric actuator, a voice coil actuator, a pager motor, a solenoid, or other type of actuator. In one embodiment, the actuator is coupled between the touch input device and a grounded surface. In another embodiment, the actuator is coupled to an inertial mass, wherein said actuator outputs an inertial force on the touch input device approximately along an axis perpendicular to the planar touch surface. A touch device microprocessor separate from the main processor of the computer can receive force information from the host computer and provide control signals based on the force information to control the actuator.

The haptic sensations, such as a pulse, vibration, or spatial texture, are preferably output in accordance with an interaction of a controlled cursor with a graphical object in the graphical environment. For example, a pulse can be output when the cursor is moved between menu elements in a menu, moved over said icon, or moved over a hyperlink. The touch input device can include multiple different regions, where at least one of the regions provides the position signal and at least one other region provides a signal that is used by the computer to control a different function, such as rate control function of a value or a button press. Different regions and borders between regions can be associated with different haptic sensations.

An embodiment advantageously provides haptic feedback to a planar touch control device of a computer, such as a touchpad or touch screen. The haptic feedback can assist and inform the user of interactions and events within a graphical user interface or other environment and ease cursor targeting tasks. Furthermore, an embodiment allows portable computer devices having such touch controls to take advantage of exist-

ing haptic feedback enabled software. The haptic touch devices disclosed herein are also inexpensive, compact and consume low power, allowing them to be easily incorporated into a wide variety of portable and desktop computers and electronic devices.

These and other advantages will become apparent to those skilled in the art upon a reading of the following specification and a study of the several figures of the drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a haptic touchpad;

FIG. **2** is a perspective view of a remote control device including the touchpad;

FIG. **3** is a perspective view of a first embodiment of the touchpad including one or more actuators coupled to the underside of the touchpad;

FIG. **4** is a side elevational view of a first embodiment in which a piezo-electric actuator is directly coupled to the touchpad;

FIG. **5** is a side elevational view of a second embodiment of the touchpad including a linear actuator;

FIG. **6** is a side elevational view of a third embodiment of the touchpad having an inertial mass;

FIG. **7** is a top plan view of an example of a touchpad having different control regions; and

FIGS. **8***a* and **8***b* are top plan and side cross sectional views, respectively, of a touch screen embodiment.

DETAILED DESCRIPTION

FIG. **1** is a perspective view of a portable computer **10** including a haptic touchpad. Computer **10** is preferably a portable or “laptop” computer that can be carried or otherwise transported by the user and may be powered by batteries or other portable energy source in addition to other more stationary power sources. Computer **10** preferably runs one or more host application programs with which a user is interacting via peripherals.

Computer **10** may include the various input and output devices as shown, including a display device **12** for outputting graphical images to the user, a keyboard **14** for providing character or toggle input from the user to the computer, and a touchpad **16**. Display device **12** can be any of a variety of types of display devices; flat-panel displays are most common on portable computers. Display device **12** can display a graphical environment **18** based on application programs and/or operating systems that are running, such as a graphical user interface (GUI), that can include a cursor **20** that can be moved by user input, as well as windows **22**, icons **24**, and other graphical objects well known in GUI environments. Other devices may also be incorporated or coupled to the computer **10**, such as storage devices (hard disk drive, DVD-ROM drive, etc.), network server or clients, game controllers, etc. In alternate embodiments, the computer **10** can take a wide variety of forms, including computing devices that rest on a tabletop or other surface, stand-up arcade game machines, other portable devices or devices worn on the person, handheld or used with a single hand of the user, etc. For example, host computer **10** can be a video game console, personal computer, workstation, a television “set top box” or a “network computer”, or other computing or electronic device.

Touchpad device **16** preferably appears externally to be similar to the touchpads of the prior art. Pad **16** includes a planar, rectangular smooth surface that can be positioned below the keyboard **14** on the housing of the computer **10**, as

shown, or may be positioned at other areas of the housing. When the user operates the computer **10**, the user may conveniently place a fingertip or other object on the touchpad **16** and move the fingertip to correspondingly move cursor **20** in the graphical environment **18**.

In operation, the touchpad **16** inputs coordinate data to the main microprocessor(s) of the computer **10** based on the sensed location of an object on (or near) the touchpad. As with many touchpads of the prior art, touchpad **16** can be capacitive, resistive, or use a different type of sensing. Some existing touchpad embodiments are disclosed, for example, in U.S. Pat. No. 5,521,336 and U.S. Pat. No. 5,943,044. Capacitive touchpads typically sense the location of an object on or near the surface of the touchpad based on capacitive coupling between capacitors in the touchpad and the object. Resistive touchpads are typically pressure-sensitive, detecting the pressure of a finger, stylus, or other object against the pad, where the pressure causes conductive layers, traces, switches, etc. in the pad to electrically connect. Some resistive or other types of touchpads can detect the amount of pressure applied by the user and can use the degree of pressure for proportional or variable input to the computer **10**. Resistive touchpads typically are at least partially deformable, so that when a pressure is applied to a particular location, the conductors at that location are brought into electrical contact. Such deformability can be useful since it can potentially amplify the magnitude of output forces such as pulses or vibrations on the touchpad. Forces can be amplified if a tuned compliant suspension is provided between an actuator and the object that is moved, as described in U.S. Pat. No. 6,680,729. Capacitive touchpads and other types of touchpads that do not require significant contact pressure may be better suited in many embodiments, since excessive pressure on the touchpad may in some cases interfere with the motion of the touchpad for haptic feedback. Other types of sensing technologies can also be used in the touchpad. Herein, the term “touchpad” preferably includes the surface of the touchpad **16** as well as any sensing apparatus included in the touchpad unit.

Touchpad **16** preferably operates similarly to existing touchpads, where the speed of the fingertip on the touchpad correlates to the distance that the cursor is moved in the graphical environment. For example, if the user moves his or her finger quickly across the pad, the cursor is moved a greater distance than if the user moves the fingertip more slowly. If the user’s finger reaches the edge of the touchpad before the cursor reaches a desired destination in that direction, then the user can simply move his or her finger off the touchpad, reposition the finger away from the edge, and continue moving the cursor. This is an “indexing” function similar to lifting a mouse off a surface to change the offset between mouse position and cursor. Furthermore, many touchpads can be provided with particular regions that are each assigned to particular functions that can be unrelated to cursor positioning. Such an embodiment is described in greater detail below with respect to FIG. **7**. In some embodiments the touchpad **16** may also allow a user to “tap” the touchpad (rapidly touch and remove the object from the pad) in a particular location to provide a command. For example, the user can tap or “double tap” the pad with a finger while the controlled cursor is over an icon to select that icon.

The touchpad **16** is provided with the ability to output haptic feedback such as tactile sensations to the user who is physically contacting the touchpad **16**. Various embodiments detailing the structure of the haptic feedback touchpad are described in greater detail below. Preferably, the forces output on the touchpad are linear (or approximately linear) and oriented along the z-axis, approximately perpendicular to the

surface of the touchpad **16** and the top surface of computer **10**. In a different embodiment, forces can be applied to the touchpad **16** to cause side-to-side (e.g., x-y) motion of the pad in the plane of its surface in addition to or instead of z-axis motion, although such motion is not preferred.

Using one or more actuators coupled to the touchpad **16**, a variety of haptic sensations can be output to the user who is contacting the pad. For example, jolts, vibrations (varying or constant amplitude), and textures can be output. Forces output on the pad can be at least in part based on the location of the finger on the pad or the state of a controlled object in the graphical environment of the host computer **10**, and/or independent of finger position or object state. Such forces output on the touchpad **16** are considered "computer-controlled" since a microprocessor or other electronic controller is controlling the magnitude and/or direction of the force output of the actuator(s) using electronic signals. Preferably, the entire pad **16** is provided with haptic sensations as a single unitary member; in other embodiments, individually-moving portions of the pad can each be provided with its own haptic feedback actuator and related transmissions so that haptic sensations can be provided for only a particular portion. For example, some embodiments may include a touchpad having different portions that may be flexed or otherwise moved with respect to other portions of the pad.

In other embodiments, the touchpad **16** can be provided in a separate housing that is connected to a port of the computer **10** via a cable or via wireless transmission and which receives force information from and sends position information to the computer **10**. For example, Universal Serial Bus (USB), Firewire, or a standard serial bus can connect such a touchpad to the computer **10**. In such an embodiment, the computer **10** can be any desktop or stationary computer or device and need not be a portable device.

One or more buttons **26** can also be provided on the housing of the computer **10** to be used in conjunction with the touchpad **16**. The user's hands have easy access to the buttons, each of which may be pressed by the user to provide a distinct input signal to the host computer **12**. Typically, each button **26** corresponds to a similar button found on a mouse input device, so that a left button can be used to select a graphical object (click or double click), a right button can bring up a context menu, etc. In some embodiments, one or more of the buttons **26** can be provided with tactile feedback as described in U.S. Pat. No. 6,184,868 and U.S. Pat. No. 6,563,487. Other features of these disclosures may also be used.

Furthermore, in some embodiments, one or more moveable portions **28** of the housing of the computer device **10** can be included which is contacted by the user when the user operates the touchpad **16** and which can provide haptic feedback. Having a moveable portion of a housing for haptic feedback is described in U.S. Pat. No. 6,184,868 and U.S. Pat. No. 6,088,019. Thus, both the housing can provide haptic feedback (e.g., through the use of an eccentric rotating mass on a motor coupled to the housing) and the touchpad **16** can provide separate haptic feedback. This allows the host to control two different tactile sensations simultaneously to the user, for example, a vibration of a low frequency can be conveyed through the housing to the user and a higher frequency vibration can be conveyed to the user through the touchpad **16**. Each other button or other control provided with haptic feedback can also provide tactile feedback independently from the other controls.

The host application program(s) and/or operating system preferably displays graphical images of the environment on display device **12**. The software and environment running on the host computer **12** may be of a wide variety. For example, the host application program can be a word processor, spreadsheet, video or computer game, drawing program, operating system, graphical user interface, simulation, Web page or browser that implements HTML or VRML instructions, scientific analysis program, virtual reality training program or application, or other application program that utilizes input from the touchpad **16** and outputs force feedback commands to the touchpad **16**. For example, many games and other application programs include force feedback functionality and may communicate with the touchpad **16** using a standard protocol/drivers such as I-Force®, FEELit®, or Touchsense™ available from Immersion Corporation of San Jose, Calif.

The touchpad **16** can include circuitry necessary to report control signals to the microprocessor of the host computer **10** and to process command signals from the host's microprocessor. For example, appropriate sensors (and related circuitry) are used to report the position of the user's finger on the touchpad **16**. The touchpad device also includes circuitry that receives signals from the host and outputs tactile sensations in accordance with the host signals using one or more actuators. In some embodiments, a separate, local microprocessor can be provided for the touchpad **16** to both report touchpad sensor data to the host and/or to carry out force commands received from the host, such commands including, for example, the type of haptic sensation and parameters describing the commanded haptic sensation. Alternatively, the touchpad microprocessor can simply pass streamed data from the main processor to the actuators. The term "force information" can include both commands/parameters and streamed data. The touchpad microprocessor can implement haptic sensations independently after receiving a host command by controlling the touchpad actuators; or, the host processor can maintain a greater degree of control over the haptic sensations by controlling the actuators more directly. In other embodiments, logic circuitry such as state machines provided for the touchpad **16** can handle haptic sensations as directed by the host main processor. Architectures and control methods that can be used for reading sensor signals and providing haptic feedback for a device are described in greater detail in U.S. Pat. No. 5,734,373 and co-pending application Nos. 60/156,354, 60,133,208, Ser. No. 09/376,649, U.S. Pat. No. 6,639,581 and 60/160,401.

FIG. **2** is a perspective view of another embodiment of a device which can include the active touchpad **16**. The device can be a handheld remote control device **30**, which the user grasps in one hand and manipulates controls to access the functions of an electronic device or appliance remotely by a user (such as a television, video cassette recorder or DVD player, audio/video receiver, Internet or network computer connected to a television, etc.). For example, several buttons **32** can be included on the remote control device **30** to manipulate functions of the controlled apparatus. A touchpad **16** can also be provided to allow the user to provide more sophisticated directional input. For example, a controlled apparatus may have a selection screen in which a cursor may be moved, and the touchpad **16** can be manipulated to control the cursor in two dimensions. The touchpad **16** includes the ability to output haptic sensations to the user as described herein, based on a controlled value or event. For example, a volume level passing a mid-point or reaching a maximum level can cause a pulse to be output to the touchpad and to the user.

In one application, the controlled apparatus can be a computer system such as Web-TV from Microsoft Corp. or other computing device which displays a graphical user interface and/or web pages accessed over a network such as the Internet. The user can control the direction of the cursor by moving

a finger (or other object) on the touchpad **16**. The cursor can be used to select and/or manipulate icons, windows, menu items, graphical buttons, slider bars, scroll bars, or other graphical objects in a graphical user interface or desktop interface. The cursor can also be used to select and/or manipulate graphical objects on a web page, such as links, images, buttons, etc. Other force sensations associated with graphical objects are described below with reference to FIG. **7**.

FIG. **3** is a perspective view of a first embodiment **40** of a touchpad **16** for providing haptic feedback to the user. In this embodiment, one or more piezoelectric actuators **42** are coupled to the underside of the touchpad **16**. The piezoelectric actuator **42** is driven by suitable electronics, as is well known to those skilled in the art. In one embodiment, a single piezoelectric actuator **42** is positioned at or near the center of the touchpad **16**, or off to one side if space constraints of the housing require such a position. In other embodiments, multiple piezoelectric actuators **42** can be positioned at different areas of the touchpad; the dashed lines show one configuration, where an actuator **42** is placed at each corner of the pad **16** and at the center of the pad.

The piezoelectric actuators **42** can each output a small pulse, vibration, or texture sensation on the touchpad **16** and to the user if the user is contacting the touchpad. The entire touchpad **16** is preferably moved with the forces output by actuator(s) **42**. Preferably, the forces output on the touchpad are linear (or approximately linear) and along the z-axis, approximately perpendicular to the surface of the touchpad **16** and the top surface of computer **10**. In a different embodiment, as mentioned above, forces can be applied to the touchpad **16** to cause side-to-side (e.g., x-y) motion of the pad in the plane of its surface in addition to or instead of z-axis motion. For example, one linear actuator can provide motion for the x-axis, and a second linear actuator can provide motion for the y-axis and/or the x-axis.

The frequency of a vibration output by an actuator **42** can be varied by providing different control signals to an actuator **42**. Furthermore, the magnitude of a pulse or vibration can be controlled based on the applied control signal. If multiple actuators **42** are provided, a stronger vibration can be imparted on the touchpad by activating two or more actuators simultaneously. Furthermore, if an actuator is positioned at an extreme end of the touchpad and is the only actuator that is activated, the user may experience a stronger vibration on the side of the touchpad having the actuator than on the opposite side of the touchpad. Different magnitudes and localized effects can be obtained by activating some but not all of the actuators. Since the tip of a user's finger that is touching the pad is fairly sensitive, the output forces do not have to be of a high magnitude for the haptic sensation to be effective and compelling.

Besides using a finger to contact the touchpad, the user may also hold other objects that directly contact the touchpad. Any haptic sensations output on the pad can be transmitted through the held object to the user's hand. For example, the user can hold a stylus having a point that contacts the touchpad **16** more precisely than a finger. Other objects may also be used. In some embodiments, specialized objects can be used to enhance the haptic sensations. For example, a stylus or other object having a flexible portion or compliance may be able to magnify at least some of the touchpad haptic sensations as experienced by the user.

The piezoelectric actuators **42** have several advantages for the touchpad **16**. These actuators can be made very thin and small, allowing their use in compact housings that are typical for portable electronic devices. They also require very low power, and are thus suitable for devices with limited power

(e.g., powered by batteries). In some embodiments described herein, power for the actuators can be drawn off a bus connecting the computer to the touchpad (or touch screen). For example, if the touchpad **16** is provided in a separate housing, a Universal Serial Bus can connect the pad to the computer and provide power from the computer to the pad as well as data (e.g. streaming force data, force commands, etc.).

FIG. **4** is a side elevational view of the embodiment **40** of the touchpad **16** as shown in FIG. **3**. Touchpad **16** is directly coupled to a grounded piezo-electric actuator **42** which operates to produce a force on the touchpad **16** when an electrical signal is input to the actuator. Typically, a piezo-electric actuator includes two layers which can move relative to each other when a current is applied to the actuator; here, the grounded portion of the actuator remains stationary with respect to the surrounding housing **41** while the moving portion of the actuator and the touchpad move with respect to the housing **41**. The operation of piezo-electric actuators to output force based on an input electrical signal is well known to those skilled the art.

The touchpad **16** can be coupled only to the actuator **42**, or can be additionally coupled to the housing of the computer device at other locations besides the actuators **42**. Preferably the other couplings are compliant connections, using a material or element such as a spring or foam. If such connections are not made compliant, then the touchpad **16** itself preferably has some compliance to allow portions of the pad to move in response to actuator forces and to convey the haptic sensations to the user more effectively.

Since the touchpad **16** is directly coupled to the actuator **42**, any produced forces are directly applied to the touchpad **16**. The electric signal preferably is obtained from a microprocessor and any circuitry required to convert the microprocessor signal to an appropriate signal for use with the actuator **42**.

FIG. **5** is a side elevational view of another embodiment **50**, in which the touchpad **16** is positioned on one or more springs **52**. The springs **52** couple the touchpad **16** to the rigid housing of the computer **10** and allow the touchpad **16** to be moved along the z-axis **56**. Only a very small range of motion is required to produce effective pulses (jolts) or vibrations on the pad **16**. Stops (not shown) can be positioned to limit the travel of the touchpad **16** to a desired range along the z-axis.

An actuator **54** is also coupled to the touchpad **16** to impart forces on the touchpad and cause the touchpad **16** to move along the z-axis. In the present embodiment, actuator **54** is a linear voice coil actuator, where the moving portion (bobbin) of the actuator is directly coupled to the touchpad **16**. The actuator **54** is grounded to the computer **10** housing and outputs a linear force on the touchpad **16** and thus drives the touchpad along the z-axis. A short pulse or jolt can be output, or the moving portion of the actuator can be oscillated to provide a vibration having a particular desired frequency. The springs **52** cause the touchpad **16** to return to a rest position after a force from the actuator causes the touchpad to move up or down. The springs can also provide a compliant suspension for the touchpad **16** and allow forces output by the actuator **54** to be amplified as explained above. Different types of spring elements can be used in other embodiments to couple the touchpad **16** to the rigid housing, such as leaf springs, foam, flexures, or other compliant materials.

In some embodiments, the user is able to push the touchpad **16** along the z-axis to provide additional input to the computer **10**. For example, a sensor can be used to detect the position of the touchpad **16** along the z-axis, such as an optical sensor, magnetic sensor, Polhemus sensor, etc. The position on the z-axis can be used to provide proportional input to the computer, for example. In addition, other types of forces can be

output along the z-axis, such as spring forces, damping forces, inertial forces, and other position-based forces, as disclosed in U.S. Pat. No. 6,563,487. In addition, 3-D elevations can be simulated in the graphical environment by moving the pad to different elevations along the z-axis. If the pad **16** can be used as an analog input depending on the distance the entire pad is moved along the z-axis, and/or if kinesthetic (force) feedback is applied in the z-axis degree of freedom, then a greater range of motion for the pad **16** along the z-axis is desirable. An elastomeric layer can be provided if the touchpad **16** is able to be pressed by the user to close a switch and provide button or switch input to the computer **10** (e.g. using contact switches, optical switches, or the like). If such z-axis movement of the pad **16** is allowed, it is preferred that the z-axis movement require a relatively large amount of force to move the pad at least initially, since such z-axis movement may not be desired during normal use of the pad by the user.

The voice coil actuator **54** preferably includes a coil and a magnet, where a current is flowed through the coil and interacts with the magnetic field of the magnet to cause a force on the moving portion of the actuator (the coil or the magnet, depending on the implementation), as is well known to those skilled in the art and is described in U.S. Pat. No. 6,184,868. Other types of actuators can also be used, such as a standard speaker, an E-core type actuator (as described in U.S. Pat. No. 6,704,001), a solenoid, a pager motor, a DC motor, moving magnet actuator (described in provisional application No. 60/133,208 and U.S. Pat. No. 6,704,001), or other type of actuator. Furthermore, the actuator can be positioned to output linear motion along an axis perpendicular to the z-axis or along another direction different from the z-axis (rotary or linear), where a mechanism converts such output motion to linear motion along the z-axis as is well known to those skilled in the art.

The touchpad **16** can also be integrated with an elastomeric layer and/or a printed circuit board in a sub-assembly, where one or more actuators are coupled to the printed circuit board to provide tactile sensations to the touchpad **16**. Helical springs can also be provided to engage electrical contacts. Or, multiple voice coil actuators can be positioned at different locations under the touchpad **16**. These embodiments are described in U.S. Pat. No. 6,563,487. Any of the actuators described in that patent can also be used.

FIG. **6** is a side elevational view of a third embodiment **60** of the haptic touchpad **16**. In this embodiment, the stationary portion of the actuator is coupled to the touchpad **16**, and the moving portion of the actuator is coupled to an inertial mass to provide inertial haptic sensations.

Touchpad **16** can be compliantly mounted to the rigid housing of the computer device similarly to the embodiments described above. For example, one or more spring elements **62** can be coupled between the touchpad and the housing. These springs can be helical or leaf springs, a compliant material such as rubber or foam, flexures, etc.

One or more actuators **64** are coupled to the underside of the touchpad **16**. In the embodiment of FIG. **6**, a piezoelectric actuator is shown. One portion **66** of each actuator **64** is coupled to the touchpad **16**, and the other portion **68** is coupled to a mass **70**. Thus, when the portion **68** is moved relative to the portion **66**, the mass **70** is moved with the portion **68**. The mass **70** can be any suitable object of the desired weight, such as plastic or metal material. The mass **70** is moved approximately along the z-axis and is not coupled to the housing, allowing free motion. The motion of the mass **70** along the z-axis causes an inertial force that is transmitted through the actuator **64** to the touchpad **16**, and the touchpad

16 moves along the z-axis due to the compliant coupling **62**. The motion of the touchpad **16** is felt by the user contacting the touchpad **16** as a haptic sensation.

In different embodiments, other types of actuators can be used. For example, a linear voice coil actuator as described for FIG. **5** can be used, in which an inertial mass is coupled to the linear-moving portion of the voice coil actuator. Other actuators can also be used, such as solenoids, pager motors, moving magnet actuators, E-core actuators, etc. Many actuators used for inertial haptic sensations are described in U.S. Pat. No. 6,211,861. Furthermore, a rotary actuator can be used, where the rotary output force is converted to a linear force approximately along the z-axis. For example, the rotary force can be converted using a flexure, as described in U.S. Pat. No. 6,697,043.

In the preferred linear force implementation, the direction or degree of freedom that the force is applied on the touchpad with respect to the inertial mass is important. If a significant component of the force is applied in the planar workspace of the touchpad (i.e., along the X or Y axis) with respect to the inertial mass, a short pulse or vibration can interfere with the user's object motion in one or both of those planar degrees of freedom and thereby impair the user's ability to accurately guide a controlled graphical object, such as a cursor, to a given target. Since a primary function of the touchpad is accurate targeting, a tactile sensation that distorts or impairs targeting, even mildly, is undesirable. To solve this problem, the touchpad device applies inertial forces substantially along the Z axis, orthogonal to the planar X and Y axes of the touchpad surface. In such a configuration, tactile sensations can be applied at a perceptually strong level for the user without impairing the ability to accurately position a user controlled graphical object in the X and Y axes of the screen. Furthermore, since the tactile sensations are directed in a third degree of freedom relative to the two-dimensional planar workspace and display screen, jolts or pulses output along the Z axis feel much more like three-dimensional bumps or divots to the user that come "out" or go "into" the screen, increasing the realism of the tactile sensations and creating a more compelling interaction. For example, an upwardly-directed pulse that is output when the cursor is moved over a window border creates the illusion that the user is moving a finger or other object "over" a bump at the window border.

FIG. **7** is a top elevational view of the touchpad **16**. Touchpad **16** can in some embodiments be used simply as a positioning device, where the entire area of the pad provides cursor control. In other embodiments, different regions of the pad can be designated for different functions. In some of these region embodiments, each region can be provided with an actuator located under the region, while other region embodiments may use a single actuator that imparts forces on the entire pad **16**. In the embodiment shown, a central cursor control region **70** is used to position the cursor.

The cursor control region **70** of the pad **16** can cause forces to be output on the pad based on interactions of the controlled cursor with the graphical environment and/or events in that environment. The user moves a finger or other object within region **70** to correspondingly move the cursor **20**. Forces are preferably associated with the interactions of the cursor with displayed graphical objects. For example, a jolt or "pulse" sensation can be output, which is a single impulse of force that quickly rises to the desired magnitude and then is turned off or quickly decays back to zero or small magnitude. The touchpad **16** can be jolted in the z-axis to provide the pulse. A vibration sensation can also be output, which is a time-varying force that is typically periodic. The vibration can cause the touchpad **16** or portions thereof to oscillate back and forth on

the z axis, and can be output by a host or local microprocessor to simulate a particular effect that is occurring in a host application.

Another type of force sensation that can be output on the touchpad **16** is a texture force. This type of force is similar to a pulse force, but depends on the position of the user's finger on the area of the touchpad and/or on the location of the cursor in the graphical environment. Thus, texture bumps are output depending on whether the cursor has moved over a location of a bump in a graphical object. This type of force is spatially-dependent, i.e. a force is output depending on the location of the cursor as it moves over a designated textured area; when the cursor is positioned between "bumps" of the texture, no force is output, and when the cursor moves over a bump, a force is output. This can be achieved by host control (e.g., the host sends the pulse signals as the cursor is dragged over the grating). In some embodiments, a separate touchpad microprocessor can be dedicated for haptic feedback with the touchpad, and the texture effect and be achieved using local control (e.g., the host sends a high level command with texture parameters and the sensation is directly controlled by the touchpad processor). In other cases a texture can be performed by presenting a vibration to a user, the vibration being dependent upon the current velocity of the user's finger (or other object) on the touchpad. When the finger is stationary, the vibration is deactivated; as the finger is moved faster, the frequency and magnitude of the vibration is increased. This sensation can be controlled locally by the touchpad processor (if present), or be controlled by the host. Local control by the pad processor may eliminate communication burden in some embodiments. Other spatial force sensations can also be output. In addition, any of the described force sensations herein can be output simultaneously or otherwise combined as desired.

Different types of graphical objects can be associated with tactile sensations. Tactile sensations can output on the touchpad **16** based on interaction between a cursor and a window. For example, a z-axis "bump" or pulse can be output on the touchpad to signal the user of the location of the cursor when the cursor is moved over a border of a window. When the cursor is moved within the window's borders, a texture force sensation can be output. The texture can be a series of bumps that are spatially arranged within the area of the window in a predefined pattern; when the cursor moves over a designated bump area, a bump force is output on the touchpad. A pulse or bump force can be output when the cursor is moved over a selectable object, such as a link in a displayed web page or an icon. A vibration can also be output to signify a graphical object which the cursor is currently positioned over. Furthermore, features of a document displaying in a window can also be associated with force sensations. For example, a pulse can be output on the touchpad when a page break in a document is scrolled past a particular area of the window. Page breaks or line breaks in a document can similarly be associated with force sensations such as bumps or vibrations.

Furthermore, a menu items in a displayed menu can be selected by the user after a menu heading or graphical button is selected. The individual menu items in the menu can be associated with forces. For example, vertical (z-axis) bumps or pulses can be output when the cursor is moved over the border between menu items. The sensations for certain menu choices can be stronger than others to indicate importance or frequency of use, i.e., the most used menu choices can be associated with higher-magnitude (stronger) pulses than the less used menu choices. Also, currently-disabled menu choices can have a weaker pulse, or no pulse, to indicate that the menu choice is not enabled at that time. Furthermore, when providing tiled menus in which a sub-menu is displayed after a particular menu element is selected, as in Microsoft Windows™, pulse sensations can be sent when a sub-menu is displayed. This can be very useful because users may not expect a sub-menu to be displayed when moving a cursor on a menu element. Icons can be associated with textures, pulses, and vibrations similarly to the windows described above. Drawing or CAD programs also have many features which can be associated with similar haptic sensations, such as displayed (or invisible) grid lines or dots, control points of a drawn object, etc.

In other related interactions, when a rate control or scrolling function is performed with the touchpad (through use of the cursor), a vibration can be displayed on the device to indicate that scrolling is in process. When reaching the end of a numerical range that is being adjusted (such as volume), a pulse can be output to indicate that the end of the range has been reached. Pulse sensations can be used to indicate the location of the "ticks" for discrete values or settings in the adjusted range. A pulse can also be output to inform the user when the center of the range is reached. Different strength pulses can also be used, larger strength indicating the more important ticks. In other instances, strength and/or frequency of a vibration can be correlated with the adjustment of a control to indicate current magnitude of the volume or other adjusted value. In other interactions, a vibration sensation can be used to indicate that a control function is active. Furthermore, in some cases a user performs a function, like selection or cutting or pasting a document, and there is a delay between the button press that commands the function and the execution of the function, due to processing delays or other delays. A pulse sensation can be used to indicate that the function (the cut or paste) has been executed.

Furthermore, the magnitude of output forces on the touchpad can depend on the event or interaction in the graphical environment. For example, the force pulse can be a different magnitude of force depending on the type of graphical object encountered by the cursor. For example, a pulses of higher magnitude can be output when the cursor moves over windows, while pulses of lower magnitude can be output when the cursor moves over icons. The magnitude of the pulses can also depend on other characteristics of graphical objects, such as an active window as distinguished a background window, file folder icons of different priorities designated by the user, icons for games as distinguished from icons for business applications, different menu items in a drop-down menu, etc. The user or developer can also preferably associate particular graphical objects with customized haptic sensations.

User-independent events can also be relayed to the user using haptic sensations on the touchpad. An event occurring within the graphical environment, such as an appointment reminder, receipt of email, explosion in a game, etc., can be signified using a vibration, pulse, or other time-based force. The force sensation can be varied to signify different events of the same type. For example, vibrations of different frequency can each be used to differentiate different events or different characteristics of events, such as particular users sending email, the priority of an event, or the initiation or conclusion of particular tasks (e.g. the downloading of a document or data over a network). When the host system is "thinking," requiring the user to wait while a function is being performed or accessed (usually when a timer is displayed by the host) it is often a surprise when the function is complete. If the user takes his or her eyes off the screen, he or she may not be aware that the function is complete. A pulse sensation can be sent to indicate that the "thinking" is over.

A software designer may want to allow a user to be able to select options or a software function by positioning a cursor over an area on the screen using the touchpad, but not require pressing a physical button or tapping the touchpad to actually select the option. Currently, it is problematic to allow such selection because a user has physical confirmation of execution when pressing a physical button. A pulse sent to the touchpad can act as that physical confirmation without the user having to press a button or other control for selection. For example, a user can position a cursor over a web page element, and once the cursor is within the desired region for a given period of time, an associated function can be executed. This is indicated to the user through a tactile pulse sent to the pad **16**.

The above-described force sensations can also be used in games or simulations. For example, a vibration can be output when a user-controlled racing car is driving on a dirt shoulder of a displayed road, a pulse can be output when the car collides with another object, and a varying-frequency vibration can be output when a vehicle engine starts and rumbles. The magnitude of pulses can be based on the severity of a collision or explosion, the size of the controlled graphical object or entity (and/or the size of a different graphical object/entity that is interacted with), etc. Force sensations can also be output based on user-independent events in the game or simulation, such as pulses when bullets are fired at the user's character.

The above haptic sensations can be similar to those described in U.S. Pat. No. 6,243,078 and U.S. Pat. No. 6,211,861. Other control devices or grips that can include a touchpad **16** in its housing include a gamepad, mouse or trackball device for manipulating a cursor or other graphical objects in a computer-generated environment; or a pressure sphere or the like. For example, the touchpad **16** can be provided on the housing of a computer mouse to provide additional input to the host computer. Furthermore, selective disturbance filtering of forces, as described in U.S. Pat. No. 6,020,876, and shaping of force signals to drive the touchpad with impulse waves as described in U.S. Pat. No. 5,959,613, can be used. Such impulses are also effective when driven with stored power in a battery on the computer **10** or from a bus such as USB connected to a host computer.

The touchpad **16** can also be provided with different control regions that provide separate input from the main cursor control region **70**. In some embodiments, the different regions can be physically marked with lines, borders, or textures on the surface of the pad **16** (and/or sounds from the computer **10**) so that the user can visually, audibly, and/or or tactilely tell which region he or she is contacting on the pad.

For example, scroll or rate control regions **72***a* and **72***b* can be used to provide input to perform a rate control task, such as scrolling documents, adjusting a value (such as audio volume, speaker balance, monitor display brightness, etc.), or panning/tilting the view in a game or virtual reality simulation. Region **72***a* can be used by placing a finger (or other object) within the region, where the upper portion of the region will increase the value, scroll up, etc., and the lower portion of the region will decrease the value, scroll down, etc. In embodiments that can read the amount of pressure placed on the pad **16**, the amount of pressure can directly control the rate of adjustment; e.g., a greater pressure will cause a document to scroll faster. The region **72***b* can similarly be used for horizontal (left/right) scrolling or rate control adjustment of a different value, view, etc.

Particular haptic effects can be associated with the control regions **72***a* and **72***b*. For example, when using the rate control region **72***a* or **72***b*, a vibration of a particular frequency

can be output on the pad **16**. In those embodiments having multiple actuators, an actuator placed directly under the region **72***a* or **72***b* can be activated to provide a more localized tactile sensation for the "active" (currently used) region. As a portion of a region **72** is pressed for rate control, pulses can be output on the pad (or region of the pad) to indicate when a page has scroll by, a particular value has passed, etc. A vibration can also be continually output while the user contacts the region **72***a* or **72***b*.

Other regions **74** can also be positioned on the touchpad **16**. For example, each of regions **74** provides a small rectangular area, like a button, which the user can point to in order to initiate a function associated with the pointed-to region. The regions **74** can initiate such computer functions as running a program, opening or closing a window, going "forward" or "back" in a queue of web pages in a web browser, powering the computer **10** or initiating a "sleep" mode, checking mail, firing a gun in a game, cutting or pasting data from a buffer, selecting a font, etc. The regions **74** can duplicate functions and buttons provided in an application program or provide new, different functions.

Similarly to regions **72** the regions **74** an each be associated with haptic sensations; for example, a region **74** can provide a pulse sensation when it has been selected by the user, providing instant feedback that the function has been selected. Furthermore, the same types of regions can be associated with similar-feeling haptic sensations. For example, each word-processor related region **74** can, when pointed to, cause a pulse of a particular strength, while each game-related region can provide a pulse of different strength or a vibration. Furthermore, when the user moves the pointing object from one region **72** or **74** to another, a haptic sensation (such as a pulse) can be output on the pad **16** to signify that a region border has been crossed.

In addition, the regions are preferably programmable in size and shape as well as in the function with which they are associated. Thus, the functions for regions **64** can change based on an active application program in the graphical environment and/or based on user preferences input to and/or stored on the computer **10**. Preferably, the size and location of each of the regions can be adjusted by the user or by an application program, and any or all of the regions can be completely removed if desired. Furthermore, the user is preferably able to assign particular haptic sensations to particular areas or types of areas based on types of functions associated with those areas, as desired. Different haptic sensations can be designed in a tool such as Immersion Studio™ available from Immersion Corporation of San Jose, Calif.

It should be noted that the regions **72** and **74** need not be physical regions of the touchpad **16**. That is, the entire touchpad **16** surface need merely provide coordinates of user contact to the processor of the computer and software on the computer can designate where different regions are located. The computer can interpret the coordinates and, based on the location of the user contact, can interpret the touchpad input signal as a cursor control signal or a different type of signal, such as rate control, button function, etc. The local touchpad microprocessor, if present, may alternatively interpret the function associated with the user contact location and report appropriate signal or data to the host processor (such as position coordinates or a button signal), thus keeping the host processor ignorant of the lower level processing. In other embodiments, the touchpad **16** can be physically designed to output different signals to the computer based on different regions marked on the touchpad surface that are contacted by the user; e.g. each region can be sensed by a different sensor or sensor array.

FIGS. **8**a and **8**b are top plan and side cross-sectional views, respectively, of another computer device embodiment **80** including a form of the haptic touchpad **16**. Device **80** is in the form of a portable computer device such as "personal digital assistant" (PDA), a "pen-based" computer, "electronic book", or similar device (collectively known as a "personal digital assistant" or PDA herein). Those devices which allow a user to input information by touching a display screen or readout in some fashion are primarily relevant to this embodiment. Such devices can include the Palm Pilot from 3Com Corp., the Newton from Apple Computer, pocket-sized computer devices from Casio, Hewlett-Packard, or other manufacturers, cellular phones or pagers having touch screens, etc.

In one embodiment of a device **80**, a display screen **82** typically covers a large portion of the surface of the computer device **80**. Screen **82** is preferably a flat-panel display as is well known to those skilled in the art and can display text, images, animations, etc.; in some embodiments screen **80** is as functional as any personal computer screen. Display screen **82** is preferably a "touch screen" that includes sensors which allow the user to input information to the computer device **80** by physically contacting the screen **80** (i.e. it is another form of planar "touch device" similar to the touchpad **16**). For example, a transparent sensor film can be overlaid on the screen **80**, where the film can detect pressure from an object contacting the film. The sensor devices for implementing touch screens are well known to those skilled in the art.

The user can select graphically-displayed buttons or other graphical objects by pressing a finger or a stylus to the screen **82** at the exact location where the graphical object is displayed. Furthermore, some embodiments allow the user to "draw" or "write" on the screen by displaying graphical "ink" images **85** at locations where the user has pressed a tip of a stylus, finger, or other object. Handwritten characters can be recognized by software running on the device microprocessor as commands, data, or other input. In other embodiments, the user can provide input additionally or alternatively through voice recognition, where a microphone on the device inputs the user's voice which is translated to appropriate commands or data by software running on the device. Physical buttons **84** can also be included in the housing of the device **80** to provide particular commands to the device **80** when the buttons are pressed. Many PDA's are characterized by the lack of a standard keyboard for character input from the user; rather, an alternative input mode is used, such as using a stylus to draw characters on the screen, voice recognition, etc. However, some PDA's also include a fully-functional keyboard as well as a touch screen, where the keyboard is typically much smaller than a standard-sized keyboard. In yet other embodiments, standard-size laptop computers with standard keyboards may include flat-panel touch-input display screens, and such screens (similar to screen **12** of FIG. **1**) can be provided with haptic feedback.

The touch screen **82** provides haptic feedback to the user similarly to the touchpad **16** described in previous embodiments. One or more actuators **86** can be coupled to the underside of the touch screen **82** to provide haptic feedback such as pulses, vibrations, and textures; for example, an actuator **86** can be positioned near each corner of the screen **82**, as shown in FIG. **8**a. Other configurations of actuators can also be used. The user can experience the haptic feedback through a finger or a held object such as a stylus **87** that is contacting the screen **82**.

As shown in FIG. **8**b, the touch screen **82** is preferably coupled to the housing **88** of the device **80** by one or more spring or compliant elements **90**, such as helical springs, leaf springs, flexures, or compliant material (foam, rubber, etc.) The compliant element allows the touch screen **82** to move approximately along the z-axis, thereby providing haptic feedback similarly to the touchpad embodiments described above. Actuators **86** can be piezo-electric actuators, voice coil actuators, or any of the other types of actuators described above for the touchpad embodiments. As shown in FIG. **8**b, the actuators **86** are directly coupled to the touch screen **82** similarly to the touchpad embodiment of FIG. **3**; alternatively, an inertial mass can be moved to provide inertial feedback in the z-axis of the touch screen, similarly to the touchpad embodiment of FIG. **6**. Other features described above for the touchpad are equally applicable to the touch screen embodiment **80**.

In the embodiments of touch input devices (touchpad and touch screen) described herein, it is also advantageous that contact of the user is detected by the touch input device. Since haptic feedback need only be output when the user is contacting the touch device, this detection allows haptic feedback to be stopped (actuators "turned off") when no objects are contacting the touch input device. This feature can conserve battery power for portable devices. If a local touch device microprocessor (or similar circuitry) is being used in the computer, such a microprocessor can turn off actuator output when no user contact is sensed, thus alleviating the host processor of additional computational burden.

While the subject matter has been described in terms of several preferred embodiments, it is contemplated that alterations, permutations, and equivalents thereof will become apparent to those skilled in the art upon a reading of the specification and study of the drawings. For example, many different types of actuators can be used to output tactile sensations to the user. Furthermore, many of the features described in one embodiment can be used interchangeably with other embodiments. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to be limiting.

What is claimed is:

1. A haptic feedback device, comprising:

a touch screen operative to display a graphical image and to output a position signal associated with cursor positioning, wherein the touch screen comprises a first region associated with the cursor positioning and a second region configured to provide a second signal different from the first signal and associated with a control functionality different from cursor positioning, and wherein the first and second regions are associated with different haptic effects; and

at least a first actuator configured to impart a first force to the touch screen to thereby provide a haptic effect in response to the cursor positioning or the control functionality different from cursor positioning, the first force based on information output by a computer device.

2. The haptic feedback device of claim **1**, wherein the computer device comprises a portable computer.

3. The haptic feedback device of claim **2**, wherein the portable computer comprises a PDA, a pager or a cellular phone.

4. The haptic feedback device of claim **1**, wherein the touch screen is provided in a housing that is separate from the computer device.

5. The haptic feedback device of claim **1**, wherein the touch screen is operative to receive a location selection from a user's finger.

6. The haptic feedback device of claim **1**, wherein the touch screen is operative to receive a location selection from a physical object held by the user.

7. The haptic feedback device of claim **6**, wherein the physical object is a stylus.

8. The haptic feedback device of claim **1**, wherein the touch screen is integrated in a housing of a handheld device that is capable of operation by at least one hand of the user.

9. The haptic feedback device of claim **8**, wherein the handheld device is a remote control device for controlling one or more functions of an electronic device or appliance.

10. The haptic feedback device of claim **1**, further comprising a second actuator coupled to the touch screen to apply a second force to the touch screen.

11. The haptic feedback device of claim **1**, wherein at least the first force is output substantially perpendicular to the plane of the touch screen.

12. The haptic feedback device of claim **1**, wherein the first actuator is a piezo-electric actuator.

13. The haptic feedback device of claim **1**, wherein the first actuator is a voice coil actuator.

14. The haptic feedback device of claim **1**, wherein the first actuator includes a solenoid.

15. The haptic feedback device of claim **1**, further comprising a touch screen microprocessor separate from the computer device configured to provide control signals to the first actuator.

16. The haptic feedback device of claim **1**, wherein the touch screen is disposed in a housing that is separate from the computer.

17. The haptic feedback device of claim **1**, further comprising a touch screen microprocessor separate from the computer device and configured to provide control signals to control the first actuator.

18. The haptic feedback device of claim **1**, wherein the first actuator outputs a continuous vibration or a pulse tactile sensation on the touch screen.

19. The haptic feedback device of claim **1**, wherein the second signal is used in a rate control function of a value.

20. The haptic feedback device of claim **1**, wherein the second signal is used in conjunction with a button press.

21. The haptic feedback device of claim **1**, wherein the second signal is used in one or more of: a running of a program, an opening or closing of a window, a navigation of a web browser, a powering on or off of a computer, an initiation of a sleep mode in a computer, an electronic mail function, a gaming function, or a word processing function.

22. The haptic feedback device of claim **1**, wherein the second signal is used in a scrolling function.

23. The haptic feedback device of claim **1**, wherein the first region is demarcated from the second region by one or more of: a visual demarcation, an audible demarcation, or a tactile demarcation.

24. The haptic feedback device of claim **1**, wherein a size or a shape of at least one of the first region or the second region is adjustable.

25. The haptic feedback device of claim **1**, wherein the first force is assignable by a user.

26. The haptic feedback device of claim **1**, further comprising a second actuator configured to provide a second force, wherein the first actuator is coupled to the first region and the second actuator is coupled to the second region to provide the second force to the second region.

27. A method, comprising:

outputting, by a touch screen operative to display a graphical image, a position signal associated with cursor positioning, wherein the touch screen comprises a first region associated with the cursor positioning and a second region configured to provide a second signal different from the first signal and associated with a control functionality different from cursor positioning, and wherein the first and second regions are associated with different haptic effects; and

imparting, by at least a first actuator, a first force to the touch screen to thereby provide a haptic effect in response to the cursor positioning or the control functionality different from cursor positioning, the first force based on information output by a computer device.

28. The method of claim **27**, wherein the second signal is used in a rate control function of a value.

29. The method of claim **27**, wherein the second signal is used in conjunction with a button press.

30. The method of claim **27**, wherein the second signal is used in one or more of: a running of a program, an opening or closing of a window, a navigation of a web browser, a powering on or off of a computer, an initiation of a sleep mode in a computer, an electronic mail function, a gaming function, or a word processing function.

31. The method of claim **27**, wherein the second signal is used in a scrolling function.

32. The method of claim **27**, wherein the first region is demarcated from the second region by one or more of: a visual demarcation, an audible demarcation, or a tactile demarcation.

33. The method of claim **27**, wherein a size or a shape of at least one of the first region or the second region is adjustable.

34. The method of claim **27**, wherein the first force is assignable by a user.

35. The method of claim **27**, further comprising imparting, by a second actuator a second force to the second region.

* * * * *

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Rosenberg et al.

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(54) **HAPTIC FEEDBACK FOR TOUCHPADS AND OTHER TOUCH CONTROLS**

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(58) **Field of Classification Search** 345/156, 345/173–183; 178/18.01, 19.01; 715/701–702; 463/30, 36–38
See application file for complete search history.

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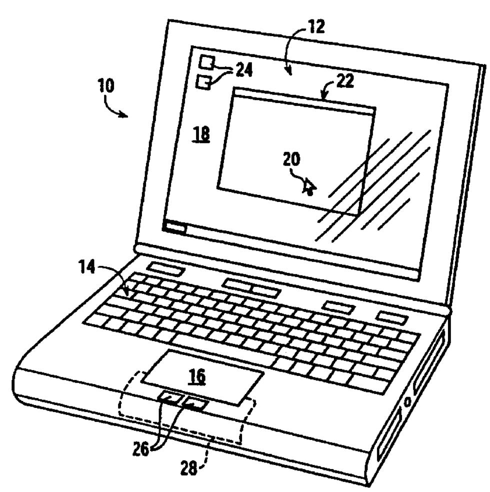
(57) **ABSTRACT**

A haptic feedback planar touch control used to provide input to a computer. A touch input device includes a planar touch surface that inputs a position signal to a processor of the computer based on a location of user contact on the touch surface. The computer can position a cursor in a displayed graphical environment based at least in part on the position signal, or perform a different function. At least one actuator is also coupled to the touch input device and outputs a force to provide a haptic sensation to the user contacting the touch surface. The touch input device can be a touchpad separate from the computer's display screen, or can be a touch screen. Output haptic sensations on the touch input device can include pulses, vibrations, and spatial textures. The touch input device can include multiple different regions to control different computer functions.

33 Claims, 5 Drawing Sheets



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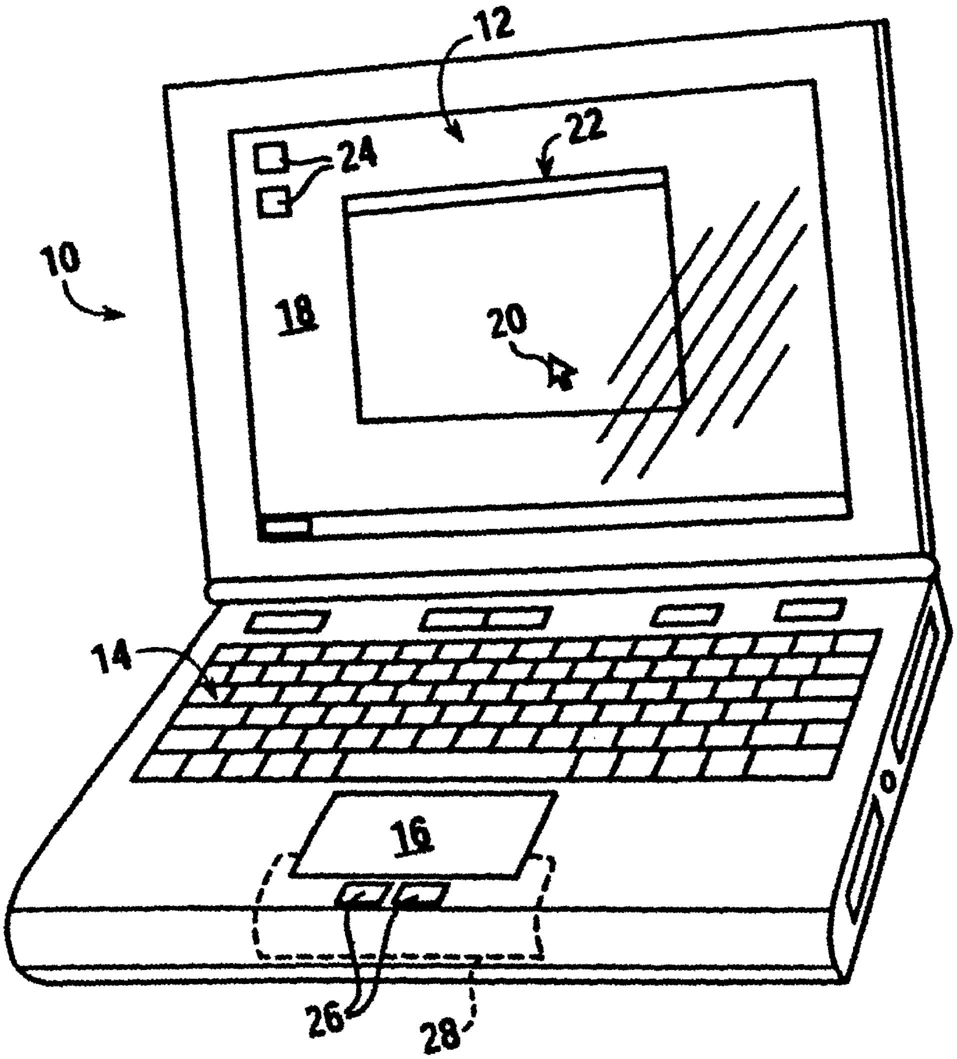


FIG. 1

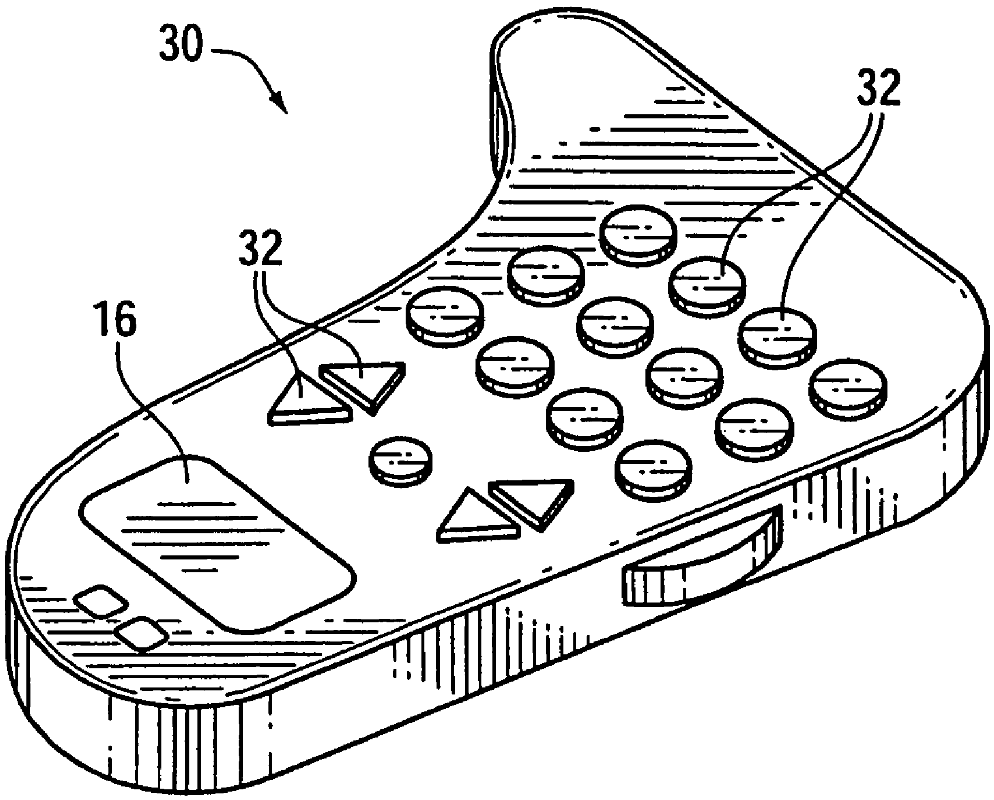


FIG. 2

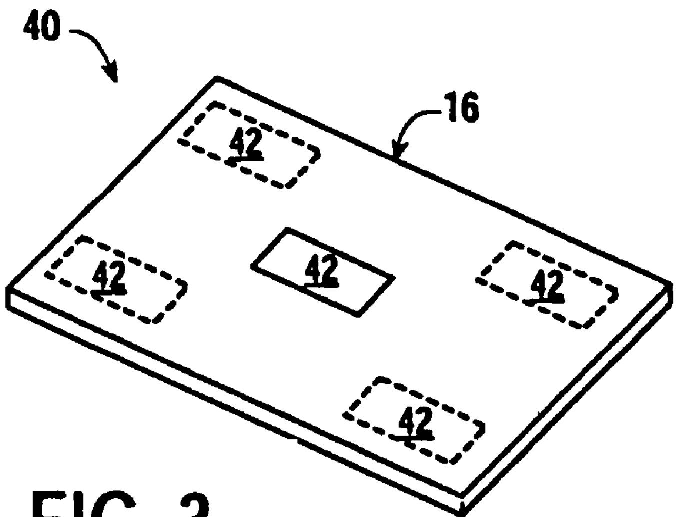


FIG. 3

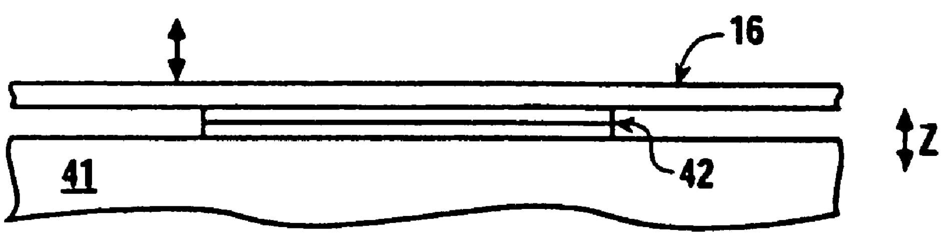


FIG. 4

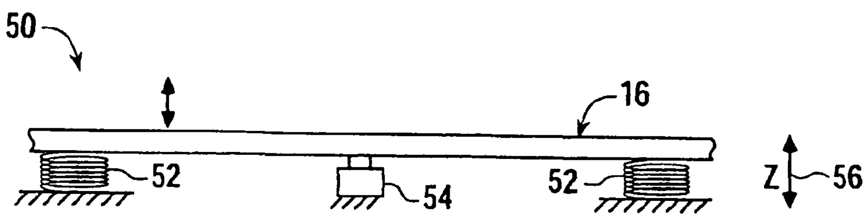


FIG. 5

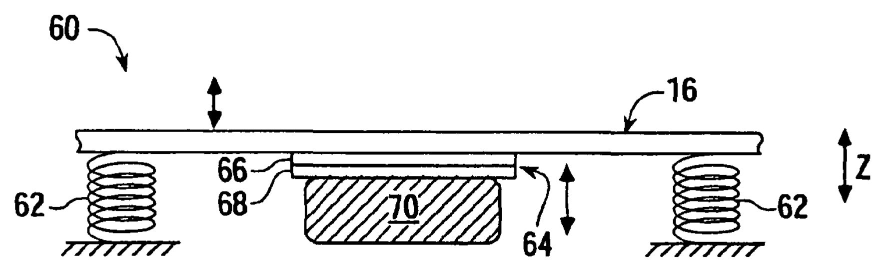


FIG. 6

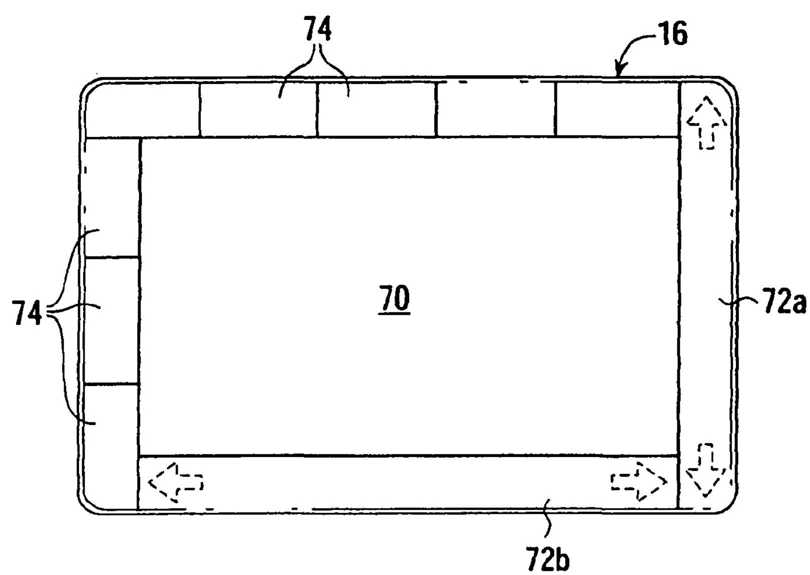


FIG. 7

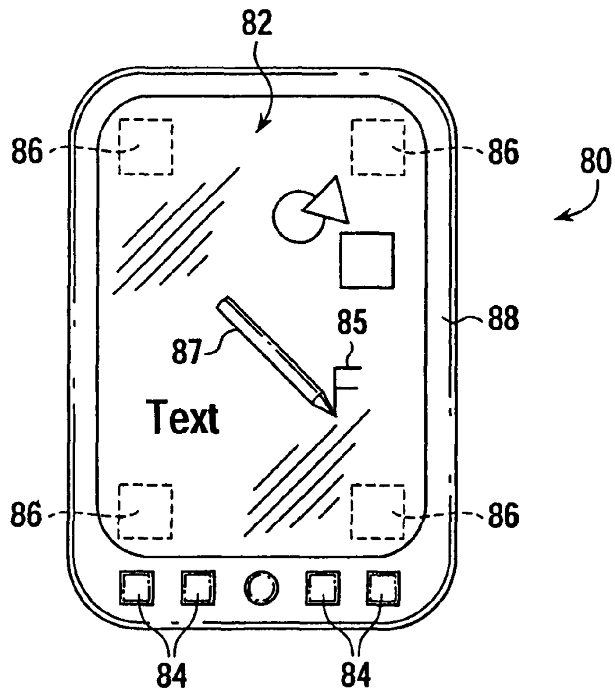


FIG. 8A

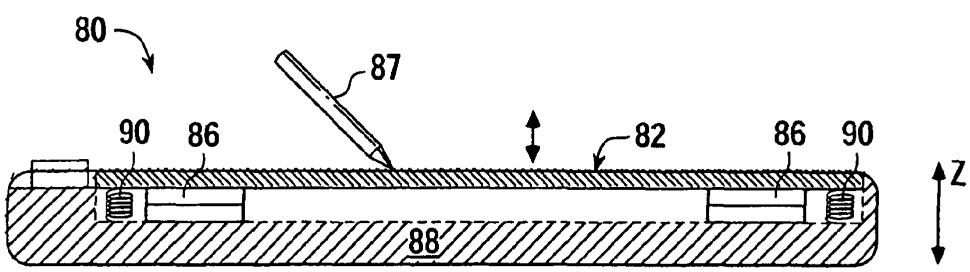


FIG. 8B

HAPTIC FEEDBACK FOR TOUCHPADS AND OTHER TOUCH CONTROLS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 11/805,609 entitled "Haptic Feedback for Touchpads and Other Touch Controls," filed May 23, 2007, which is a continuation of U.S. Pat. No. 7,148,875, entitled "Haptic Feedback for Touchpads and Other Touch Controls," issued Dec. 12, 2006, which is a continuation of U.S. Pat. No. 6,429,846, entitled "Haptic Feedback for Touchpads and Other Touch Controls," issued Aug. 6, 2002, which is a continuation-in-part of U.S. Pat. No. 6,563,487, entitled "Haptic Feedback for Directional Control Pads," issued May 13, 2003, which is a continuation-in-part of U.S. Pat. No. 6,243,078, entitled "Low Cost Force Feedback Pointing Device," issued Jun. 5, 2001, which is a continuation-in-part of U.S. Pat. No. 6,184,868, entitled "Haptic Feedback Control Devices," issued Feb. 6, 2001, which is a continuation-in-part of U.S. Pat. No. 6,088,019, entitled "Low Cost Force Feedback Device with Actuator for Non-Primary Axis," issued Jul. 11, 2000.

BACKGROUND

The subject matter described relates generally to the interfacing with computer and mechanical devices by a user, and more particularly to devices used to interface with computer systems and electronic devices and which provide haptic feedback to the user.

Humans interface with electronic and mechanical devices in a variety of applications, and the need for a more natural, easy-to-use, and informative interface is a constant concern. In the context, humans interface with computer devices for a variety of applications. One such application is interacting with computer-generated environments such as games, simulations, and application programs. Computer input devices such as mice and trackballs are often used to control a cursor within a graphical environment and provide input in these applications.

In some interface devices, force feedback or tactile feedback is also provided to the user, collectively known herein as "haptic feedback." For example, haptic versions of joysticks, mice, gamepads, steering wheels, or other types of devices can output forces to the user based on events or interactions occurring within the graphical environment, such as in a game or other application program.

In portable computer or electronic devices, such as laptop computers, mice typically too large a workspace to be practical. As a result, more compact devices such as trackballs are often used. A more popular device for portable computers are "touchpads," which are small rectangular, planar pads provided near the keyboard of the computer. The touchpads senses the location of a pointing object by any of a variety of sensing technologies, such as capacitive sensors or pressure sensors that detect pressure applied to the touchpad. The user contacts the touchpad most commonly with a fingertip and moves his or her finger on the pad to move a cursor displayed in the graphical environment. In other embodiments, the user can operate a stylus in conjunction with the touchpad by pressing the stylus tip on the touchpad and moving the stylus.

One problem with existing touchpads is that there is no haptic feedback provided to the user. The user of a touchpad is therefore not able to experience haptic sensations that assist and inform the user of targeting and other control tasks within

the graphical environment. The touchpads of the prior art also cannot take advantage of existing haptic-enabled software run on the portable computer.

OVERVIEW

An embodiment is directed to a haptic feedback planar touch control used to provide input to a computer system. The control can be a touchpad provided on a portable computer, or can be a touch screen found on a variety of devices. The haptic sensations output on the touch control enhance interactions and manipulations in a displayed graphical environment or when controlling an electronic device.

More specifically, the embodiment relates to a haptic feedback touch control for inputting signals to a computer and for outputting forces to a user of the touch control. The control includes a touch input device including an approximately planar touch surface operative to input a position signal to a processor of said computer based on a location of user contact on the touch surface. The computer positions a cursor in a graphical environment displayed on a display device based at least in part on the position signal. At least one actuator is also coupled to the touch input device and outputs a force on the touch input device to provide a haptic sensation to the user contacting the touch surface. The actuator outputs the force based on force information output by the processor to the actuator.

The touch input device can be a touchpad separate from a display screen of the computer, or can be included in a display screen of the computer as a touch screen. The touch input device can be integrated in a housing of the computer or handheld device, or provided in a housing that is separate from the computer. The user contacts the touch surface with a finger, a stylus, or other object. The force is preferably a linear force output approximately perpendicularly to a plane of the touch surface of the touch input device, and the actuator can include a piezo-electric actuator, a voice coil actuator, a pager motor, a solenoid, or other type of actuator. In one embodiment, the actuator is coupled between the touch input device and a grounded surface. In another embodiment, the actuator is coupled to an inertial mass, wherein said actuator outputs an inertial force on the touch input device approximately along an axis perpendicular to the planar touch surface. A touch device microprocessor separate from the main processor of the computer can receive force information from the host computer and provide control signals based on the force information to control the actuator.

The haptic sensations, such as a pulse, vibration, or spatial texture, are preferably output in accordance with an interaction of a controlled cursor with a graphical object in the graphical environment. For example, a pulse can be output when the cursor is moved between menu elements in a menu, moved over said icon, or moved over a hyperlink. The touch input device can include multiple different regions, where at least one of the regions provides the position signal and at least one other region provides a signal that is used by the computer to control a different function, such as rate control function of a value or a button press. Different regions and borders between regions can be associated with different haptic sensations.

An embodiment advantageously provides haptic feedback to a planar touch control device of a computer, such as a touchpad or touch screen. The haptic feedback can assist and inform the user of interactions and events within a graphical user interface or other environment and ease cursor targeting tasks. Furthermore, an embodiment allows portable computer devices having such touch controls to take advantage of exist-

ing haptic feedback enabled software. The haptic touch devices disclosed herein are also inexpensive, compact and consume low power, allowing them to be easily incorporated into a wide variety of portable and desktop computers and electronic devices.

These and other advantages will become apparent to those skilled in the art upon a reading of the following specification and a study of the several figures of the drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a haptic touchpad;

FIG. **2** is a perspective view of a remote control device including the touchpad;

FIG. **3** is a perspective view of a first embodiment of the touchpad including one or more actuators coupled to the underside of the touchpad;

FIG. **4** is a side elevational view of a first embodiment in which a piezo-electric actuator is directly coupled to the touchpad;

FIG. **5** is a side elevational view of a second embodiment of the touchpad including a linear actuator;

FIG. **6** is a side elevational view of a third embodiment of the touchpad having an inertial mass;

FIG. **7** is a top plan view of an example of a touchpad having different control regions; and

FIGS. **8***a* and **8***b* are top plan and side cross sectional views, respectively, of a touch screen embodiment.

DETAILED DESCRIPTION

FIG. **1** is a perspective view of a portable computer **10** including a haptic touchpad. Computer **10** is preferably a portable or “laptop” computer that can be carried or otherwise transported by the user and may be powered by batteries or other portable energy source in addition to other more stationary power sources. Computer **10** preferably runs one or more host application programs with which a user is interacting via peripherals.

Computer **10** may include the various input and output devices as shown, including a display device **12** for outputting graphical images to the user, a keyboard **14** for providing character or toggle input from the user to the computer, and a touchpad **16**. Display device **12** can be any of a variety of types of display devices; flat-panel displays are most common on portable computers. Display device **12** can display a graphical environment **18** based on application programs and/or operating systems that are running, such as a graphical user interface (GUI), that can include a cursor **20** that can be moved by user input, as well as windows **22**, icons **24**, and other graphical objects well known in GUI environments. Other devices may also be incorporated or coupled to the computer **10**, such as storage devices (hard disk drive, DVD-ROM drive, etc.), network server or clients, game controllers, etc. In alternate embodiments, the computer **10** can take a wide variety of forms, including computing devices that rest on a tabletop or other surface, stand-up arcade game machines, other portable devices or devices worn on the person, handheld or used with a single hand of the user, etc. For example, host computer **10** can be a video game console, personal computer, workstation, a television “set top box” or a “network computer”, or other computing or electronic device.

Touchpad device **16** preferably appears externally to be similar to the touchpads of the prior art. Pad **16** includes a planar, rectangular smooth surface that can be positioned below the keyboard **14** on the housing of the computer **10**, as shown, or may be positioned at other areas of the housing. When the user operates the computer **10**, the user may conveniently place a fingertip or other object on the touchpad **16** and move the fingertip to correspondingly move cursor **20** in the graphical environment **18**.

In operation, the touchpad **16** inputs coordinate data to the main microprocessor(s) of the computer **10** based on the sensed location of an object on (or near) the touchpad. As with many touchpads of the prior art, touchpad **16** can be capacitive, resistive, or use a different type of sensing. Some existing touchpad embodiments are disclosed, for example, in U.S. Pat. No. 5,521,336 and U.S. Pat. No. 5,943,044. Capacitive touchpads typically sense the location of an object on or near the surface of the touchpad based on capacitive coupling between capacitors in the touchpad and the object. Resistive touchpads are typically pressure-sensitive, detecting the pressure of a finger, stylus, or other object against the pad, where the pressure causes conductive layers, traces, switches, etc. in the pad to electrically connect. Some resistive or other types of touchpads can detect the amount of pressure applied by the user and can use the degree of pressure for proportional or variable input to the computer **10**. Resistive touchpads typically are at least partially deformable, so that when a pressure is applied to a particular location, the conductors at that location are brought into electrical contact. Such deformability can be useful since it can potentially amplify the magnitude of output forces such as pulses or vibrations on the touchpad. Forces can be amplified if a tuned compliant suspension is provided between an actuator and the object that is moved, as described in U.S. Pat. No. 6,680,729. Capacitive touchpads and other types of touchpads that do not require significant contact pressure may be better suited in many embodiments, since excessive pressure on the touchpad may in some cases interfere with the motion of the touchpad for haptic feedback. Other types of sensing technologies can also be used in the touchpad. Herein, the term “touchpad” preferably includes the surface of the touchpad **16** as well as any sensing apparatus included in the touchpad unit.

Touchpad **16** preferably operates similarly to existing touchpads, where the speed of the fingertip on the touchpad correlates to the distance that the cursor is moved in the graphical environment. For example, if the user moves his or her finger quickly across the pad, the cursor is moved a greater distance than if the user moves the fingertip more slowly. If the user’s finger reaches the edge of the touchpad before the cursor reaches a desired destination in that direction, then the user can simply move his or her finger off the touchpad, reposition the finger away from the edge, and continue moving the cursor. This is an “indexing” function similar to lifting a mouse off a surface to change the offset between mouse position and cursor. Furthermore, many touchpads can be provided with particular regions that are each assigned to particular functions that can be unrelated to cursor positioning. Such an embodiment is described in greater detail below with respect to FIG. **7**. In some embodiments the touchpad **16** may also allow a user to “tap” the touchpad (rapidly touch and remove the object from the pad) in a particular location to provide a command. For example, the user can tap or “double tap” the pad with a finger while the controlled cursor is over an icon to select that icon.

The touchpad **16** is provided with the ability to output haptic feedback such as tactile sensations to the user who is physically contacting the touchpad **16**. Various embodiments detailing the structure of the haptic feedback touchpad are described in greater detail below. Preferably, the forces output on the touchpad are linear (or approximately linear) and oriented along the z-axis, approximately perpendicular to the

surface of the touchpad **16** and the top surface of computer **10**. In a different embodiment, forces can be applied to the touchpad **16** to cause side-to-side (e.g., x-y) motion of the pad in the plane of its surface in addition to or instead of z-axis motion, although such motion is not preferred.

Using one or more actuators coupled to the touchpad **16**, a variety of haptic sensations can be output to the user who is contacting the pad. For example, jolts, vibrations (varying or constant amplitude), and textures can be output. Forces output on the pad can be at least in part based on the location of the finger on the pad or the state of a controlled object in the graphical environment of the host computer **10**, and/or independent of finger position or object state. Such forces output on the touchpad **16** are considered "computer-controlled" since a microprocessor or other electronic controller is controlling the magnitude and/or direction of the force output of the actuator(s) using electronic signals. Preferably, the entire pad **16** is provided with haptic sensations as a single unitary member; in other embodiments, individually-moving portions of the pad can each be provided with its own haptic feedback actuator and related transmissions so that haptic sensations can be provided for only a particular portion. For example, some embodiments may include a touchpad having different portions that may be flexed or otherwise moved with respect to other portions of the pad.

In other embodiments, the touchpad **16** can be provided in a separate housing that is connected to a port of the computer **10** via a cable or via wireless transmission and which receives force information from and sends position information to the computer **10**. For example, Universal Serial Bus (USB), Firewire, or a standard serial bus can connect such a touchpad to the computer **10**. In such an embodiment, the computer **10** can be any desktop or stationary computer or device and need not be a portable device.

One or more buttons **26** can also be provided on the housing of the computer **10** to be used in conjunction with the touchpad **16**. The user's hands have easy access to the buttons, each of which may be pressed by the user to provide a distinct input signal to the host computer **12**. Typically, each button **26** corresponds to a similar button found on a mouse input device, so that a left button can be used to select a graphical object (click or double click), a right button can bring up a context menu, etc. In some embodiments, one or more of the buttons **26** can be provided with tactile feedback as described in U.S. Pat. No. 6,184,868 and U.S. Pat. No. 6,563,487. Other features of these disclosures may also be used.

Furthermore, in some embodiments, one or more moveable portions **28** of the housing of the computer device **10** can be included which is contacted by the user when the user operates the touchpad **16** and which can provide haptic feedback. Having a moveable portion of a housing for haptic feedback is described in U.S. Pat. No. 6,184,868 and U.S. Pat. No. 6,088,019. Thus, both the housing can provide haptic feedback (e.g., through the use of an eccentric rotating mass on a motor coupled to the housing) and the touchpad **16** can provide separate haptic feedback. This allows the host to control two different tactile sensations simultaneously to the user, for example, a vibration of a low frequency can be conveyed through the housing to the user and a higher frequency vibration can be conveyed to the user through the touchpad **16**. Each other button or other control provided with haptic feedback can also provide tactile feedback independently from the other controls.

The host application program(s) and/or operating system preferably displays graphical images of the environment on display device **12**. The software and environment running on the host computer **12** may be of a wide variety. For example, the host application program can be a word processor, spreadsheet, video or computer game, drawing program, operating system, graphical user interface, simulation, Web page or browser that implements HTML or VRML instructions, scientific analysis program, virtual reality training program or application, or other application program that utilizes input from the touchpad **16** and outputs force feedback commands to the touchpad **16**. For example, many games and other application programs include force feedback functionality and may communicate with the touchpad **16** using a standard protocol/drivers such as I-Force®, FEELit®, or Touchsense™ available from Immersion Corporation of San Jose, Calif.

The touchpad **16** can include circuitry necessary to report control signals to the microprocessor of the host computer **10** and to process command signals from the host's microprocessor. For example, appropriate sensors (and related circuitry) are used to report the position of the user's finger on the touchpad **16**. The touchpad device also includes circuitry that receives signals from the host and outputs tactile sensations in accordance with the host signals using one or more actuators. In some embodiments, a separate, local microprocessor can be provided for the touchpad **16** to both report touchpad sensor data to the host and/or to carry out force commands received from the host, such commands including, for example, the type of haptic sensation and parameters describing the commanded haptic sensation. Alternatively, the touchpad microprocessor can simply pass streamed data from the main processor to the actuators. The term "force information" can include both commands/parameters and streamed data. The touchpad microprocessor can implement haptic sensations independently after receiving a host command by controlling the touchpad actuators; or, the host processor can maintain a greater degree of control over the haptic sensations by controlling the actuators more directly. In other embodiments, logic circuitry such as state machines provided for the touchpad **16** can handle haptic sensations as directed by the host main processor. Architectures and control methods that can be used for reading sensor signals and providing haptic feedback for a device are described in greater detail in U.S. Pat. No. 5,734,373 and co-pending application Nos. 60/156,354, 60,133,208, Ser. No. 09/376,649, U.S. Pat. No. 6,639,581 and 60/160,401.

FIG. **2** is a perspective view of another embodiment of a device which can include the active touchpad **16**. The device can be a handheld remote control device **30**, which the user grasps in one hand and manipulates controls to access the functions of an electronic device or appliance remotely by a user (such as a television, video cassette recorder or DVD player, audio/video receiver, Internet or network computer connected to a television, etc.). For example, several buttons **32** can be included on the remote control device **30** to manipulate functions of the controlled apparatus. A touchpad **16** can also be provided to allow the user to provide more sophisticated directional input. For example, a controlled apparatus may have a selection screen in which a cursor may be moved, and the touchpad **16** can be manipulated to control the cursor in two dimensions. The touchpad **16** includes the ability to output haptic sensations to the user as described herein, based on a controlled value or event. For example, a volume level passing a mid-point or reaching a maximum level can cause a pulse to be output to the touchpad and to the user.

In one application, the controlled apparatus can be a computer system such as Web-TV from Microsoft Corp. or other computing device which displays a graphical user interface and/or web pages accessed over a network such as the Internet. The user can control the direction of the cursor by moving

a finger (or other object) on the touchpad **16**. The cursor can be used to select and/or manipulate icons, windows, menu items, graphical buttons, slider bars, scroll bars, or other graphical objects in a graphical user interface or desktop interface. The cursor can also be used to select and/or manipulate graphical objects on a web page, such as links, images, buttons, etc. Other force sensations associated with graphical objects are described below with reference to FIG. **7**.

FIG. **3** is a perspective view of a first embodiment **40** of a touchpad **16** for providing haptic feedback to the user. In this embodiment, one or more piezoelectric actuators **42** are coupled to the underside of the touchpad **16**. The piezoelectric actuator **42** is driven by suitable electronics, as is well known to those skilled in the art. In one embodiment, a single piezoelectric actuator **42** is positioned at or near the center of the touchpad **16**, or off to one side if space constraints of the housing require such a position. In other embodiments, multiple piezoelectric actuators **42** can be positioned at different areas of the touchpad; the dashed lines show one configuration, where an actuator **42** is placed at each corner of the pad **16** and at the center of the pad.

The piezoelectric actuators **42** can each output a small pulse, vibration, or texture sensation on the touchpad **16** and to the user if the user is contacting the touchpad. The entire touchpad **16** is preferably moved with the forces output by actuator(s) **42**. Preferably, the forces output on the touchpad are linear (or approximately linear) and along the z-axis, approximately perpendicular to the surface of the touchpad **16** and the top surface of computer **10**. In a different embodiment, as mentioned above, forces can be applied to the touchpad **16** to cause side-to-side (e.g., x-y) motion of the pad in the plane of its surface in addition to or instead of z-axis motion. For example, one linear actuator can provide motion for the x-axis, and a second linear actuator can provide motion for the y-axis and/or the x-axis.

The frequency of a vibration output by an actuator **42** can be varied by providing different control signals to an actuator **42**. Furthermore, the magnitude of a pulse or vibration can be controlled based on the applied control signal. If multiple actuators **42** are provided, a stronger vibration can be imparted on the touchpad by activating two or more actuators simultaneously. Furthermore, if an actuator is positioned at an extreme end of the touchpad and is the only actuator that is activated, the user may experience a stronger vibration on the side of the touchpad having the actuator than on the opposite side of the touchpad. Different magnitudes and localized effects can be obtained by activating some but not all of the actuators. Since the tip of a user's finger that is touching the pad is fairly sensitive, the output forces do not have to be of a high magnitude for the haptic sensation to be effective and compelling.

Besides using a finger to contact the touchpad, the user may also hold other objects that directly contact the touchpad. Any haptic sensations output on the pad can be transmitted through the held object to the user's hand. For example, the user can hold a stylus having a point that contacts the touchpad **16** more precisely than a finger. Other objects may also be used. In some embodiments, specialized objects can be used to enhance the haptic sensations. For example, a stylus or other object having a flexible portion or compliance may be able to magnify at least some of the touchpad haptic sensations as experienced by the user.

The piezoelectric actuators **42** have several advantages for the touchpad **16**. These actuators can be made very thin and small, allowing their use in compact housings that are typical for portable electronic devices. They also require very low power, and are thus suitable for devices with limited power (e.g., powered by batteries). In some embodiments described herein, power for the actuators can be drawn off a bus connecting the computer to the touchpad (or touch screen). For example, if the touchpad **16** is provided in a separate housing, a Universal Serial Bus can connect the pad to the computer and provide power from the computer to the pad as well as data (e.g. streaming force data, force commands, etc.).

FIG. **4** is a side elevational view of the embodiment **40** of the touchpad **16** as shown in FIG. **3**. Touchpad **16** is directly coupled to a grounded piezo-electric actuator **42** which operates to produce a force on the touchpad **16** when an electrical signal is input to the actuator. Typically, a piezo-electric actuator includes two layers which can move relative to each other when a current is applied to the actuator; here, the grounded portion of the actuator remains stationary with respect to the surrounding housing **41** while the moving portion of the actuator and the touchpad move with respect to the housing **41**. The operation of piezo-electric actuators to output force based on an input electrical signal is well known to those skilled the art.

The touchpad **16** can be coupled only to the actuator **42**, or can be additionally coupled to the housing of the computer device at other locations besides the actuators **42**. Preferably the other couplings are compliant connections, using a material or element such as a spring or foam. If such connections are not made compliant, then the touchpad **16** itself preferably has some compliance to allow portions of the pad to move in response to actuator forces and to convey the haptic sensations to the user more effectively.

Since the touchpad **16** is directly coupled to the actuator **42**, any produced forces are directly applied to the touchpad **16**. The electric signal preferably is obtained from a microprocessor and any circuitry required to convert the microprocessor signal to an appropriate signal for use with the actuator **42**.

FIG. **5** is a side elevational view of another embodiment **50**, in which the touchpad **16** is positioned on one or more springs **52**. The springs **52** couple the touchpad **16** to the rigid housing of the computer **10** and allow the touchpad **16** to be moved along the z-axis **56**. Only a very small range of motion is required to produce effective pulses (jolts) or vibrations on the pad **16**. Stops (not shown) can be positioned to limit the travel of the touchpad **16** to a desired range along the z-axis.

An actuator **54** is also coupled to the touchpad **16** to impart forces on the touchpad and cause the touchpad **16** to move along the z-axis. In the present embodiment, actuator **54** is a linear voice coil actuator, where the moving portion (bobbin) of the actuator is directly coupled to the touchpad **16**. The actuator **54** is grounded to the computer **10** housing and outputs a linear force on the touchpad **16** and thus drives the touchpad along the z-axis. A short pulse or jolt can be output, or the moving portion of the actuator can be oscillated to provide a vibration having a particular desired frequency. The springs **52** cause the touchpad **16** to return to a rest position after a force from the actuator causes the touchpad to move up or down. The springs can also provide a compliant suspension for the touchpad **16** and allow forces output by the actuator **54** to be amplified as explained above. Different types of spring elements can be used in other embodiments to couple the touchpad **16** to the rigid housing, such as leaf springs, foam, flexures, or other compliant materials.

In some embodiments, the user is able to push the touchpad **16** along the z-axis to provide additional input to the computer **10**. For example, a sensor can be used to detect the position of the touchpad **16** along the z-axis, such as an optical sensor, magnetic sensor, Polhemus sensor, etc. The position on the z-axis can be used to provide proportional input to the computer, for example. In addition, other types of forces can be

output along the z-axis, such as spring forces, damping forces, inertial forces, and other position-based forces, as disclosed in U.S. Pat. No. 6,563,487. In addition, 3-D elevations can be simulated in the graphical environment by moving the pad to different elevations along the z-axis. If the pad **16** can be used as an analog input depending on the distance the entire pad is moved along the z-axis, and/or if kinesthetic (force) feedback is applied in the z-axis degree of freedom, then a greater range of motion for the pad **16** along the z-axis is desirable. An elastomeric layer can be provided if the touchpad **16** is able to be pressed by the user to close a switch and provide button or switch input to the computer **10** (e.g. using contact switches, optical switches, or the like). If such z-axis movement of the pad **16** is allowed, it is preferred that the z-axis movement require a relatively large amount of force to move the pad at least initially, since such z-axis movement may not be desired during normal use of the pad by the user.

The voice coil actuator **54** preferably includes a coil and a magnet, where a current is flowed through the coil and interacts with the magnetic field of the magnet to cause a force on the moving portion of the actuator (the coil or the magnet, depending on the implementation), as is well known to those skilled in the art and is described in U.S. Pat. No. 6,184,868. Other types of actuators can also be used, such as a standard speaker, an E-core type actuator (as described in U.S. Pat. No. 6,704,001), a solenoid, a pager motor, a DC motor, moving magnet actuator (described in provisional application No. 60/133,208 and U.S. Pat. No. 6,704,001), or other type of actuator. Furthermore, the actuator can be positioned to output linear motion along an axis perpendicular to the z-axis or along another direction different from the z-axis (rotary or linear), where a mechanism converts such output motion to linear motion along the z-axis as is well known to those skilled in the art.

The touchpad **16** can also be integrated with an elastomeric layer and/or a printed circuit board in a sub-assembly, where one or more actuators are coupled to the printed circuit board to provide tactile sensations to the touchpad **16**. Helical springs can also be provided to engage electrical contacts. Or, multiple voice coil actuators can be positioned at different locations under the touchpad **16**. These embodiments are described in U.S. Pat. No. 6,563,487. Any of the actuators described in that patent can also be used.

FIG. **6** is a side elevational view of a third embodiment **60** of the haptic touchpad **16**. In this embodiment, the stationary portion of the actuator is coupled to the touchpad **16**, and the moving portion of the actuator is coupled to an inertial mass to provide inertial haptic sensations.

Touchpad **16** can be compliantly mounted to the rigid housing of the computer device similarly to the embodiments described above. For example, one or more spring elements **62** can be coupled between the touchpad and the housing. These springs can be helical or leaf springs, a compliant material such as rubber or foam, flexures, etc.

One or more actuators **64** are coupled to the underside of the touchpad **16**. In the embodiment of FIG. **6**, a piezoelectric actuator is shown. One portion **66** of each actuator **64** is coupled to the touchpad **16**, and the other portion **68** is coupled to a mass **70**. Thus, when the portion **68** is moved relative to the portion **66**, the mass **70** is moved with the portion **68**. The mass **70** can be any suitable object of the desired weight, such as plastic or metal material. The mass **70** is moved approximately along the z-axis and is not coupled to the housing, allowing free motion. The motion of the mass **70** along the z-axis causes an inertial force that is transmitted through the actuator **64** to the touchpad **16**, and the touchpad **16** moves along the z-axis due to the compliant coupling **62**. The motion of the touchpad **16** is felt by the user contacting the touchpad **16** as a haptic sensation.

In different embodiments, other types of actuators can be used. For example, a linear voice coil actuator as described for FIG. **5** can be used, in which an inertial mass is coupled to the linear-moving portion of the voice coil actuator. Other actuators can also be used, such as solenoids, pager motors, moving magnet actuators, E-core actuators, etc. Many actuators used for inertial haptic sensations are described in U.S. Pat. No. 6,211,861. Furthermore, a rotary actuator can be used, where the rotary output force is converted to a linear force approximately along the z-axis. For example, the rotary force can be converted using a flexure, as described in U.S. Pat. No. 6,697,043.

In the preferred linear force implementation, the direction or degree of freedom that the force is applied on the touchpad with respect to the inertial mass is important. If a significant component of the force is applied in the planar workspace of the touchpad (i.e., along the X or Y axis) with respect to the inertial mass, a short pulse or vibration can interfere with the user's object motion in one or both of those planar degrees of freedom and thereby impair the user's ability to accurately guide a controlled graphical object, such as a cursor, to a given target. Since a primary function of the touchpad is accurate targeting, a tactile sensation that distorts or impairs targeting, even mildly, is undesirable. To solve this problem, the touchpad device applies inertial forces substantially along the Z axis, orthogonal to the planar X and Y axes of the touchpad surface. In such a configuration, tactile sensations can be applied at a perceptually strong level for the user without impairing the ability to accurately position a user controlled graphical object in the X and Y axes of the screen. Furthermore, since the tactile sensations are directed in a third degree of freedom relative to the two-dimensional planar workspace and display screen, jolts or pulses output along the Z axis feel much more like three-dimensional bumps or divots to the user that come "out" or go "into" the screen, increasing the realism of the tactile sensations and creating a more compelling interaction. For example, an upwardly-directed pulse that is output when the cursor is moved over a window border creates the illusion that the user is moving a finger or other object "over" a bump at the window border.

FIG. **7** is a top elevational view of the touchpad **16**. Touchpad **16** can in some embodiments be used simply as a positioning device, where the entire area of the pad provides cursor control. In other embodiments, different regions of the pad can be designated for different functions. In some of these region embodiments, each region can be provided with an actuator located under the region, while other region embodiments may use a single actuator that imparts forces on the entire pad **16**. In the embodiment shown, a central cursor control region **70** is used to position the cursor.

The cursor control region **70** of the pad **16** can cause forces to be output on the pad based on interactions of the controlled cursor with the graphical environment and/or events in that environment. The user moves a finger or other object within region **70** to correspondingly move the cursor **20**. Forces are preferably associated with the interactions of the cursor with displayed graphical objects. For example, a jolt or "pulse" sensation can be output, which is a single impulse of force that quickly rises to the desired magnitude and then is turned off or quickly decays back to zero or small magnitude. The touchpad **16** can be jolted in the z-axis to provide the pulse. A vibration sensation can also be output, which is a time-varying force that is typically periodic. The vibration can cause the touchpad **16** or portions thereof to oscillate back and forth on

the z axis, and can be output by a host or local microprocessor to simulate a particular effect that is occurring in a host application.

Another type of force sensation that can be output on the touchpad **16** is a texture force. This type of force is similar to a pulse force, but depends on the position of the user's finger on the area of the touchpad and/or on the location of the cursor in the graphical environment. Thus, texture bumps are output depending on whether the cursor has moved over a location of a bump in a graphical object. This type of force is spatially-dependent, i.e. a force is output depending on the location of the cursor as it moves over a designated textured area; when the cursor is positioned between "bumps" of the texture, no force is output, and when the cursor moves over a bump, a force is output. This can be achieved by host control (e.g., the host sends the pulse signals as the cursor is dragged over the grating). In some embodiments, a separate touchpad microprocessor can be dedicated for haptic feedback with the touchpad, and the texture effect and be achieved using local control (e.g., the host sends a high level command with texture parameters and the sensation is directly controlled by the touchpad processor). In other cases a texture can be performed by presenting a vibration to a user, the vibration being dependent upon the current velocity of the user's finger (or other object) on the touchpad. When the finger is stationary, the vibration is deactivated; as the finger is moved faster, the frequency and magnitude of the vibration is increased. This sensation can be controlled locally by the touchpad processor (if present), or be controlled by the host. Local control by the pad processor may eliminate communication burden in some embodiments. Other spatial force sensations can also be output. In addition, any of the described force sensations herein can be output simultaneously or otherwise combined as desired.

Different types of graphical objects can be associated with tactile sensations. Tactile sensations can output on the touchpad **16** based on interaction between a cursor and a window. For example, a z-axis "bump" or pulse can be output on the touchpad to signal the user of the location of the cursor when the cursor is moved over a border of a window. When the cursor is moved within the window's borders, a texture force sensation can be output. The texture can be a series of bumps that are spatially arranged within the area of the window in a predefined pattern; when the cursor moves over a designated bump area, a bump force is output on the touchpad. A pulse or bump force can be output when the cursor is moved over a selectable object, such as a link in a displayed web page or an icon. A vibration can also be output to signify a graphical object which the cursor is currently positioned over. Furthermore, features of a document displaying in a window can also be associated with force sensations. For example, a pulse can be output on the touchpad when a page break in a document is scrolled past a particular area of the window. Page breaks or line breaks in a document can similarly be associated with force sensations such as bumps or vibrations.

Furthermore, a menu items in a displayed menu can be selected by the user after a menu heading or graphical button is selected. The individual menu items in the menu can be associated with forces. For example, vertical (z-axis) bumps or pulses can be output when the cursor is moved over the border between menu items. The sensations for certain menu choices can be stronger than others to indicate importance or frequency of use, i.e., the most used menu choices can be associated with higher-magnitude (stronger) pulses than the less used menu choices. Also, currently-disabled menu choices can have a weaker pulse, or no pulse, to indicate that the menu choice is not enabled at that time. Furthermore, when providing tiled menus in which a sub-menu is displayed after a particular menu element is selected, as in Microsoft Windows™, pulse sensations can be sent when a sub-menu is displayed. This can be very useful because users may not expect a sub-menu to be displayed when moving a cursor on a menu element. Icons can be associated with textures, pulses, and vibrations similarly to the windows described above. Drawing or CAD programs also have many features which can be associated with similar haptic sensations, such as displayed (or invisible) grid lines or dots, control points of a drawn object, etc.

In other related interactions, when a rate control or scrolling function is performed with the touchpad (through use of the cursor), a vibration can be displayed on the device to indicate that scrolling is in process. When reaching the end of a numerical range that is being adjusted (such as volume), a pulse can be output to indicate that the end of the range has been reached. Pulse sensations can be used to indicate the location of the "ticks" for discrete values or settings in the adjusted range. A pulse can also be output to inform the user when the center of the range is reached. Different strength pulses can also be used, larger strength indicating the more important ticks. In other instances, strength and/or frequency of a vibration can be correlated with the adjustment of a control to indicate current magnitude of the volume or other adjusted value. In other interactions, a vibration sensation can be used to indicate that a control function is active. Furthermore, in some cases a user performs a function, like selection or cutting or pasting a document, and there is a delay between the button press that commands the function and the execution of the function, due to processing delays or other delays. A pulse sensation can be used to indicate that the function (the cut or paste) has been executed.

Furthermore, the magnitude of output forces on the touchpad can depend on the event or interaction in the graphical environment. For example, the force pulse can be a different magnitude of force depending on the type of graphical object encountered by the cursor. For example, a pulses of higher magnitude can be output when the cursor moves over windows, while pulses of lower magnitude can be output when the cursor moves over icons. The magnitude of the pulses can also depend on other characteristics of graphical objects, such as an active window as distinguished a background window, file folder icons of different priorities designated by the user, icons for games as distinguished from icons for business applications, different menu items in a drop-down menu, etc. The user or developer can also preferably associate particular graphical objects with customized haptic sensations.

User-independent events can also be relayed to the user using haptic sensations on the touchpad. An event occurring within the graphical environment, such as an appointment reminder, receipt of email, explosion in a game, etc., can be signified using a vibration, pulse, or other time-based force. The force sensation can be varied to signify different events of the same type. For example, vibrations of different frequency can each be used to differentiate different events or different characteristics of events, such as particular users sending email, the priority of an event, or the initiation or conclusion of particular tasks (e.g. the downloading of a document or data over a network). When the host system is "thinking," requiring the user to wait while a function is being performed or accessed (usually when a timer is displayed by the host) it is often a surprise when the function is complete. If the user takes his or her eyes off the screen, he or she may not be aware that the function is complete. A pulse sensation can be sent to indicate that the "thinking" is over.

A software designer may want to allow a user to be able to select options or a software function by positioning a cursor over an area on the screen using the touchpad, but not require pressing a physical button or tapping the touchpad to actually select the option. Currently, it is problematic to allow such selection because a user has physical confirmation of execution when pressing a physical button. A pulse sent to the touchpad can act as that physical confirmation without the user having to press a button or other control for selection. For example, a user can position a cursor over a web page element, and once the cursor is within the desired region for a given period of time, an associated function can be executed. This is indicated to the user through a tactile pulse sent to the pad **16**.

The above-described force sensations can also be used in games or simulations. For example, a vibration can be output when a user-controlled racing car is driving on a dirt shoulder of a displayed road, a pulse can be output when the car collides with another object, and a varying-frequency vibration can be output when a vehicle engine starts and rumbles. The magnitude of pulses can be based on the severity of a collision or explosion, the size of the controlled graphical object or entity (and/or the size of a different graphical object/entity that is interacted with), etc. Force sensations can also be output based on user-independent events in the game or simulation, such as pulses when bullets are fired at the user's character.

The above haptic sensations can be similar to those described in U.S. Pat. No. 6,243,078 and U.S. Pat. No. 6,211,861. Other control devices or grips that can include a touchpad **16** in its housing include a gamepad, mouse or trackball device for manipulating a cursor or other graphical objects in a computer-generated environment; or a pressure sphere or the like. For example, the touchpad **16** can be provided on the housing of a computer mouse to provide additional input to the host computer. Furthermore, selective disturbance filtering of forces, as described in U.S. Pat. No. 6,020,876, and shaping of force signals to drive the touchpad with impulse waves as described in U.S. Pat. No. 5,959,613, can be used. Such impulses are also effective when driven with stored power in a battery on the computer **10** or from a bus such as USB connected to a host computer.

The touchpad **16** can also be provided with different control regions that provide separate input from the main cursor control region **70**. In some embodiments, the different regions can be physically marked with lines, borders, or textures on the surface of the pad **16** (and/or sounds from the computer **10**) so that the user can visually, audibly, and/or or tactilely tell which region he or she is contacting on the pad.

For example, scroll or rate control regions **62***a* and **62***b* can be used to provide input to perform a rate control task, such as scrolling documents, adjusting a value (such as audio volume, speaker balance, monitor display brightness, etc.), or panning/tilting the view in a game or virtual reality simulation. Region **62***a* can be used by placing a finger (or other object) within the region, where the upper portion of the region will increase the value, scroll up, etc., and the lower portion of the region will decrease the value, scroll down, etc. In embodiments that can read the amount of pressure placed on the pad **16**, the amount of pressure can directly control the rate of adjustment; e.g., a greater pressure will cause a document to scroll faster. The region **62***b* can similarly be used for horizontal (left/right) scrolling or rate control adjustment of a different value, view, etc.

Particular haptic effects can be associated with the control regions **62***a* and **62***b*. For example, when using the rate control region **62***a* or **62***b*, a vibration of a particular frequency

can be output on the pad **16**. In those embodiments having multiple actuators, an actuator placed directly under the region **62***a* or **62***b* can be activated to provide a more localized tactile sensation for the "active" (currently used) region. As a portion of a region **62** is pressed for rate control, pulses can be output on the pad (or region of the pad) to indicate when a page has scroll by, a particular value has passed, etc. A vibration can also be continually output while the user contacts the region **62***a* or **62***b*.

Other regions **64** can also be positioned on the touchpad **16**. For example, each of regions **64** provides a small rectangular area, like a button, which the user can point to in order to initiate a function associated with the pointed-to region. The regions **64** can initiate such computer functions as running a program, opening or closing a window, going "forward" or "back" in a queue of web pages in a web browser, powering the computer **10** or initiating a "sleep" mode, checking mail, firing a gun in a game, cutting or pasting data from a buffer, selecting a font, etc. The regions **64** can duplicate functions and buttons provided in an application program or provide new, different functions.

Similarly to regions **62**, the regions **64** an each be associated with haptic sensations; for example, a region **64** can provide a pulse sensation when it has been selected by the user, providing instant feedback that the function has been selected. Furthermore, the same types of regions can be associated with similar-feeling haptic sensations. For example, each word processor related region **64** can, when pointed to, cause a pulse of a particular strength, while each game-related region can provide a pulse of different strength or a vibration. Furthermore, when the user moves the pointing object from one region **62** or **64** to another, a haptic sensation (such as a pulse) can be output on the pad **16** to signify that a region border has been crossed.

In addition, the regions are preferably programmable in size and shape as well as in the function with which they are associated. Thus, the functions for regions **64** can change based on an active application program in the graphical environment and/or based on user preferences input to and/or stored on the computer **10**. Preferably, the size and location of each of the regions can be adjusted by the user or by an application program, and any or all of the regions can be completely removed if desired. Furthermore, the user is preferably able to assign particular haptic sensations to particular areas or types of areas based on types of functions associated with those areas, as desired. Different haptic sensations can be designed in a tool such as Immersion Studio™ available from Immersion Corporation of San Jose, Calif.

It should be noted that the regions **62** and **64** need not be physical regions of the touchpad **16**. That is, the entire touchpad **16** surface need merely provide coordinates of user contact to the processor of the computer and software on the computer can designate where different regions are located. The computer can interpret the coordinates and, based on the location of the user contact, can interpret the touchpad input signal as a cursor control signal or a different type of signal, such as rate control, button function, etc. The local touchpad microprocessor, if present, may alternatively interpret the function associated with the user contact location and report appropriate signal or data to the host processor (such as position coordinates or a button signal), thus keeping the host processor ignorant of the lower level processing. In other embodiments, the touchpad **16** can be physically designed to output different signals to the computer based on different regions marked on the touchpad surface that are contacted by the user; e.g. each region can be sensed by a different sensor or sensor array.

FIGS. **8***a* and **8***b* are top plan and side cross-sectional views, respectively, of another computer device embodiment **80** including a form of the haptic touchpad **16**. Device **80** is in the form of a portable computer device such as "personal digital assistant" (PDA), a "pen-based" computer, "electronic book", or similar device (collectively known as a "personal digital assistant" or PDA herein). Those devices which allow a user to input information by touching a display screen or readout in some fashion are primarily relevant to this embodiment. Such devices can include the Palm Pilot from 3Com Corp., the Newton from Apple Computer, pocket-sized computer devices from Casio, Hewlett-Packard, or other manufacturers, cellular phones or pagers having touch screens, etc.

For example, scroll or rate control regions **72***a* and **72***b* can be used to provide input to perform a rate control task, such as scrolling documents, adjusting a value (such as audio volume, speaker balance, monitor display brightness, etc.), or panning/tilting the view in a game or virtual reality simulation. Region **72***a* can be used by placing a finger (or other object) within the region, where the upper portion of the region will increase the value, scroll up, etc., and the lower portion of the region will decrease the value, scroll down, etc. In embodiments that can read the amount of pressure placed on the pad **16**, the amount of pressure can directly control the rate of adjustment; e.g., a greater pressure will cause a document to scroll faster. The region **72***b* can similarly be used for horizontal (left/right) scrolling or rate control adjustment of a different value, view, etc.

Particular haptic effects can be associated with the control regions **72***a* and **72***b*. For example, when using the rate control region **72***a* or **72***b*, a vibration of a particular frequency can be output on the pad **16**. In those embodiments having multiple actuators, an actuator placed directly under the region **72***a* or **72***b* can be activated to provide a more localized tactile sensation for the "active" (currently used) region. As a portion of a region **72** is pressed for rate control, pulses can be output on the pad (or region of the pad) to indicate when a page has scroll by, a particular value has passed, etc. A vibration can also be continually output while the user contacts the region **72***a* or **72***b*.

Other regions **74** can also be positioned on the touchpad **16**. For example, each of regions **74** provides a small rectangular area, like a button, which the user can point to in order to initiate a function associated with the pointed-to region. The regions **74** can initiate such computer functions as running a program, opening or closing a window, going "forward" or "back" in a queue of web pages in a web browser, powering the computer **10** or initiating a "sleep" mode, checking mail, firing a gun in a game, cutting or pasting data from a buffer, selecting a font, etc. The regions **74** can duplicate functions and buttons provided in an application program or provide new, different functions.

Similarly to regions **72**, the regions **74** an each be associated with haptic sensations; for example, a region **74** can provide a pulse sensation when it has been selected by the user, providing instant feedback that the function has been selected. Furthermore, the same types of regions can be associated with similar-feeling haptic sensations. For example, each word-processor related region **74** can, when pointed to, cause a pulse of a particular strength, while each game-related region can provide a pulse of different strength or a vibration. Furthermore, when the user moves the pointing object from one region **72** or **74** to another, a haptic sensation (such as a pulse) can be output on the pad **16** to signify that a region border has been crossed.

In the embodiments of touch input devices (touchpad and touch screen) described herein, it is also advantageous that contact of the user is detected by the touch input device. Since haptic feedback need only be output when the user is contacting the touch device, this detection allows haptic feedback to be stopped (actuators "turned off") when no objects are contacting the touch input device. This feature can conserve battery power for portable devices. If a local touch device microprocessor (or similar circuitry) is being used in the computer, such a microprocessor can turn off actuator output when no user contact is sensed, thus alleviating the host processor of additional computational burden.

It should be noted that the regions **72** and **74** need not be physical regions of the touchpad **16**. That is, the entire touchpad **16** surface need merely provide coordinates of user contact to the processor of the computer and software on the computer can designate where different regions are located. The computer can interpret the coordinates and, based on the location of the user contact, can interpret the touchpad input signal as a cursor control signal or a different type of signal, such as rate control, button function, etc. The local touchpad microprocessor, if present, may alternatively interpret the function associated with the user contact location and report appropriate signal or data to the host processor (such as position coordinates or a button signal), thus keeping the host processor ignorant of the lower level processing. In other embodiments, the touchpad **16** can be physically designed to output different signals to the computer based on different regions marked on the touchpad surface that are contacted by the user; e.g. each region can be sensed by a different sensor or sensor array.

What is claimed is:

1. A haptic feedback device comprising:

a display configured to display one or more graphical items, at least one of which has an active state; and

an actuator configured to impart to the haptic feedback device a haptic force associated with a displayed graphical item that is in an active state and a second haptic force associated with a displayed graphical item that is in an inactive state.

2. The haptic feedback device of claim **1**, wherein the haptic feedback device comprises a desktop computer, a laptop computer, or a handheld device.

3. The haptic feedback device of claim **2**, wherein the handheld device comprises a computer game controller, a cell phone, a PDA or a multi-media remote controller.

4. The haptic feedback device of claim **1**, wherein the display comprises a touch screen.

5. A haptic feedback device, comprising:

a touch screen configured to sense a user's input on the touch screen and display a graphical interface having a plurality of graphical objects, wherein the user's input imparts a scrolling action among the plurality of graphical objects in the graphical interface; and

at least one actuator configured to:

output a first haptic effect based on the user's input at an edge of a scrolling control region of the touch screen; and

output a second haptic effect upon sensing the user's input at another location on the scrolling control region.

6. The haptic feedback device of claim **5**, wherein the haptic feedback device comprises a desktop computer, a laptop computer, or a handheld device.

7. The haptic feedback device of claim **6**, wherein the handheld device comprises a computer game controller, a cell phone, a PDA or a multi-media remote controller.

8. The haptic feedback device of claim **6**, wherein the handheld device comprises a microprocessor for controlling haptic effects.

9. A haptic feedback device, comprising:

a touch screen configured to:

display a graphical interface having a plurality of graphical objects;

sense a user's input on the touch screen; and

output a first signal based on the user's input, wherein the first signal causes a scrolling action among the plurality of graphical objects in the graphical interface in response to the user's input;

a computer configured to receive the first signal; and

at least one actuator coupled to the touch screen and configured to impart a force to the touch screen to thereby provide a haptic effect in response to the first signal, the force being based on a second signal output by the computer.

10. A haptic feedback device, comprising:

a touch screen operative to output a first signal indicative of a contacted location on the touch screen, wherein the touch screen includes a first region associated with a cursor positioning, and at least one other region, distinct from the first region, associated with a control functionality different from cursor positioning;

a computer configured to receive the first signal; and

at least one actuator coupled to the touch screen and configured to impart a force to the touch screen to thereby provide a haptic effect in response to said contact, said force being based on a second signal output by the computer.

11. The haptic feedback device of claim **10**, wherein the control functionality different from cursor positioning is chosen from the group consisting of: scroll control, rate control, audio volume control, audio balance control, display brightness control, display contrast control, display size control, display view control, menu control, program control, window display control, window viewing sequence control, word processing control, and video game function control.

12. The haptic feedback device of claim **10**, wherein the touch screen is configured to provide a command from a tap.

13. The haptic feedback device of claim **10**, wherein the at least one actuator outputs the force at least in part based on a location of a finger on the touch screen.

14. The haptic feedback device of claim **10**, wherein the touch screen is provided in a separate housing that is connected to the computer through a cable or a wireless transmission.

15. The haptic feedback device of claim **10**, wherein the computer comprises a desktop computer, a laptop computer, or a handheld device.

16. The haptic feedback device of claim **15**, wherein the handheld device comprises a computer game controller, a cell phone, a PDA or a multi-media remote controller.

17. The haptic feedback device of claim **16**, wherein the handheld device comprises a microprocessor for controlling haptic effects.

18. The haptic feedback device of claim **17**, wherein: the first tactile sensation to be of a first frequency, and the second tactile sensation to be of a second frequency.

19. The haptic feedback device of claim **16**, wherein the handheld device is graspable in one hand by a user and the touch screen is contactable by a finger of the grasping hand.

20. The haptic feedback device of claim **10**, further comprising: a first actuator connected to a housing of the haptic feedback device; and a second actuator coupled to the touch screen.

21. The haptic feedback device of claim **20**, wherein: the first actuator imparts a first tactile sensation to a user; and the second actuator imparts a second tactile sensation to the user.

22. The haptic feedback device of claim **10**, further comprising: at least one sensor to sense a position of a user's finger on the touch screen.

23. The haptic feedback device of claim **10**, wherein the touch screen is configured to control a value or an event.

24. The haptic feedback device of claim **23**, wherein the event can be a value of a volume level passing a mid-point or reaching a maximum level to cause the force to be imparted to the touch screen.

25. The haptic feedback device of claim **10**, wherein the touch screen is configured to respond to a handheld object.

26. The haptic feedback device of claim **25**, wherein the handheld object is a stylus.

27. The haptic feedback device of claim **10**, wherein the touch screen is capable of being pushed by a user to provide a switch input to the computer.

28. The haptic feedback device of claim **10**, wherein each of the first region and the at least one other region has a corresponding actuator coupled thereto.

29. The haptic feedback device of claim **10**, further comprising: surface indicia on the touch screen that separate the first region and the at least one other region.

30. The haptic feedback device of claim **25**, wherein the surface indicia are chosen from the group consisting of lines, borders and textures.

31. The haptic feedback device of claim **10**, wherein the touch screen is configured to determine an amount of pressure on the touch screen.

32. The haptic feedback device of claim **31**, wherein the amount of pressure directly controls a rate of adjustment of a feature.

33. The haptic feedback device of claim **10**, wherein areas of the first region and the at least one other region are programmably adjustable in size and shape.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,982,720 B2
APPLICATION NO. : 11/985656
DATED : July 19, 2011
INVENTOR(S) : Louis B. Rosenberg et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In column 13, line 50, "62a and 62b" should be --72a and 72b--.

In column 13, line 55, "62a" should be --72a--.

In column 13, line 62, "62b" should be --72b--.

In column 13, line 66, "62a and 62b" should be --72a and 72b--.

In column 13, line 67, "62a or 62b" should be --72a or 72b--.

In column 14, line 3, "62a or 62b" should be --72a or 72b--.

In column 14, line 5, "62" should be --72--.

In column 14, line 9, "62a or 62b" should be --72a or 72b--.

In column 14, line 10, "64" should be --74--.

In column 14, line 11, "64" should be --74--.

In column 14, line 14, "64" should be --74--

In column 14, line 19, "64" should be --74--.

In column 14, line 22, "regions 62, the regions 64" should be --regions 72, the regions 74--.

In column 14, line 23, "64" should be --74--.

In column 14, line 28, "64" should be --74--.

Signed and Sealed this
Twenty-fifth Day of October, 2011

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

In column 14, line 32, "62 or 64" should be --72 or 74--.

In column 14, line 49, "62 and 64" should be --72 and 74--.

Column 15, lines 14-65, should be:

--In one embodiment of a device 80, a display screen 82 typically covers a large portion of the surface of the computer device 80. Screen 82 is preferably a flat-panel display as is well known to those skilled in the art and can display text, images, animations, etc.; in some embodiments screen 80 is as functional as any personal computer screen. Display screen 82 is preferably a "touch screen" that includes sensors which allow the user to input information to the computer device 80 by physically contacting the screen 80 (i.e. it is another form of planar "touch device" similar to the touchpad 16). For example, a transparent sensor film can be overlaid on the screen 80, where the film can detect pressure from an object contacting the film. The sensor devices for implementing touch screens are well known to those skilled in the art.

The user can select graphically-displayed buttons or other graphical objects by pressing a finger or a stylus to the screen 82 at the exact location where the graphical object is displayed. Furthermore, some embodiments allow the user to "draw" or "write" on the screen by displaying graphical "ink" images 85 at locations where the user has pressed a tip of a stylus, finger, or other object. Handwritten characters can be recognized by software running on the device microprocessor as commands, data, or other input. In other embodiments, the user can provide input additionally or alternatively through voice recognition, where a microphone on the device inputs the user's voice which is translated to appropriate commands or data by software running on the device. Physical buttons 84 can also be included in the housing of the device 80 to provide particular commands to the device 80 when the buttons are pressed. Many PDA's are characterized by the lack of a standard keyboard for character input from the user; rather, an alternative input mode is used, such as using a stylus to draw characters on the screen, voice recognition, etc.

However, some PDA's also include a fully-functional keyboard as well as a touch screen, where the keyboard is typically much smaller than a standard-sized keyboard. In yet other embodiments, standard-size laptop computers with standard keyboards may include flat-panel touch-input display screens, and such screens (similar to screen 12 of FIG. 1) can be provided with haptic feedback.

The touch screen 82 provides haptic feedback to the user similarly to the touchpad 16 described in previous embodiments. One or more actuators 86 can be coupled to the underside of the touch screen 82 to provide haptic feedback such as pulses, vibrations, and textures; for example, an actuator 86 can be positioned near each corner of the screen 82, as shown in FIG. 8a. Other configurations of actuators can also be used. The user can experience the haptic feedback through a finger or a held object such as a stylus 87 that is contacting the screen 82.

(Continued on next page)

(Continued from previous page)

As shown in FIG. 8b, the touch screen 82 is preferably coupled to the housing 88 of the device 80 by one or more spring or compliant elements 90, such as helical springs, leaf springs, flexures, or compliant material (foam, rubber, etc.) The compliant element allows the touch screen 82 to move approximately along the z-axis, thereby providing haptic feedback similarly to the touchpad embodiments described above. Actuators 86 can be piezo-electric actuators, voice coil actuators, or any of the other types of actuators described above for the touchpad embodiments. As shown in FIG. 8b, the actuators 86 are directly coupled to the touch screen 82 similarly to the touchpad embodiment of FIG. 3; alternatively, an inertial mass can be moved to provide inertial feedback in the z-axis of the touch screen, similarly to the touchpad embodiment of FIG. 6. Other features described above for the touchpad are equally applicable to the touch screen embodiment 80.--.

Column 16, lines 11-29, should be:

--While the subject matter has been described in terms of several preferred embodiments, it is contemplated that alterations, permutations, and equivalents thereof will become apparent to those skilled in the art upon a reading of the specification and study of the drawings. For example, many different types of actuators can be used to output tactile sensations to the user. Furthermore, many of the features described in one embodiment can be used interchangeably with other embodiments. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to be limiting.--.

US007982720C1

(12) **EX PARTE REEXAMINATION CERTIFICATE** (10046th)

United States Patent (10) **Number: US 7,982,720 C1**

Rosenberg et al. (45) **Certificate Issued: Feb. 18, 2014**

(54) **HAPTIC FEEDBACK FOR TOUCHPADS AND OTHER TOUCH CONTROLS**

(75) Inventors: **Louis B. Rosenberg**, San Jose, CA (US); **James R. Riegel**, Santa Clara, CA (US)

(73) Assignee: **Immersion Corporation**, San Jose, CA (US)

Reexamination Request:
No. 90/012,486, Sep. 10, 2012

Reexamination Certificate for:

Patent No.:	**7,982,720**
Issued:	**Jul. 19, 2011**
Appl. No.:	**11/985,656**
Filed:	**Nov. 15, 2007**

Certificate of Correction issued Oct. 25, 2011

Related U.S. Application Data

(63) Continuation of application No. 11/805,609, filed on May 23, 2007, now abandoned, which is a continuation of application No. 10/213,940, filed on Aug. 6, 2002, now Pat. No. 7,148,875, which is a continuation of application No. 09/487,737, filed on Jan. 19, 2000, now Pat. No. 6,429,846, which is a continuation-in-part of application No. 09/467,309, filed on Dec. 17, 1999, now Pat. No. 6,563,487, which is a continuation-in-part of application No. 09/253,132, filed on Feb. 18, 1999, now Pat. No. 6,243,078, which is a continuation-in-part of application No. 09/156,802, filed on Sep. 17, 1998, now Pat. No. 6,184,868, which is a continuation-in-part of application No. 09/103,281, filed on Jun. 23, 1998, now Pat. No. 6,088,019.

(51) **Int. Cl.**

G06F 3/041	(2006.01)
A63F 13/06	(2006.01)
G06F 1/16	(2006.01)
G06F 3/0362	(2013.01)
G06F 3/0354	(2013.01)
G06F 3/0485	(2013.01)
G06F 3/0488	(2013.01)
G06F 3/0338	(2013.01)

(52) **U.S. Cl.**
CPC ***A63F 13/06*** (2013.01); *G06F 1/1626* (2013.01); *G06F 3/0362* (2013.01); *G06F 3/03545* (2013.01); *G06F 3/0416* (2013.01); *G06F 3/04855* (2013.01); *G06F 3/04886* (2013.01); *G06G 3/011* (2013.01); *G06F 3/0338* (2013.01)
USPC **345/173**; 178/18.01; 463/30

(58) **Field of Classification Search**
None
See application file for complete search history.

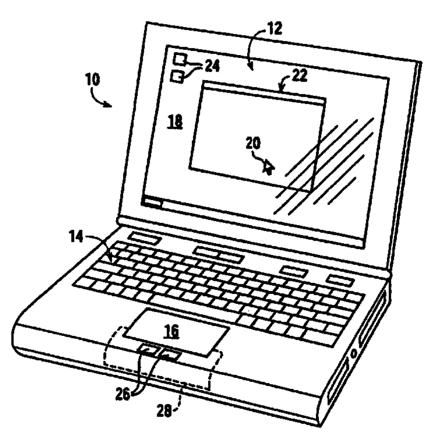
(56) **References Cited**

To view the complete listing of prior art documents cited during the proceeding for Reexamination Control Number 90/012,486, please refer to the USPTO's public Patent Application Information Retrieval (PAIR) system under the Display References tab.

Primary Examiner — Mark Sager

(57) **ABSTRACT**

A haptic feedback planar touch control used to provide input to a computer. A touch input device includes a planar touch surface that inputs a position signal to a processor of the computer based on a location of user contact on the touch surface. The computer can position a cursor in a displayed graphical environment based at least in part on the position signal, or perform a different function. At least one actuator is also coupled to the touch input device and outputs a force to provide a haptic sensation to the user contacting the touch surface. The touch input device can be a touchpad separate from the computer's display screen, or can be a touch screen. Output haptic sensations on the touch input device can include pulses, vibrations, and spatial textures. The touch input device can include multiple different regions to control different computer functions.



EX PARTE REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

Claims **1-4** are cancelled.

Claims **10-11** and **30** are determined to be patentable as amended.

Claims **12-13**, **15-17**, **19**, **22-23**, **29** and **33**, dependent on an amended claim, are determined to be patentable.

Claims **5-9**, **14**, **18**, **20-21**, **24-28** and **31-32** were not reexamined.

10. A haptic feedback device, comprising:

a touch screen operative to output a first signal **[**indicative**]** *comprising coordinates* of a contacted location on the

touch screen, wherein the touch screen includes a first region associated with a cursor positioning, and at least one other *non-overlapping control* region**[**, distinct from the first region, associated with a control functionality different from**]** *not related to* cursor positioning;

a computer configured to receive the first signal; and

at least one actuator coupled to the touch screen and configured to impart a force to the touch screen to thereby provide a haptic effect in response to said contact, said force being based on a second signal output by the computer.

11. The haptic feedback device of claim **10**, wherein the *non-overlapping* control **[**functionality different from**]** *region not related to* cursor positioning is chosen from the group consisting of: scroll control, rate control, audio volume control, audio balance control, display brightness control, display contrast control, display size control, display view control, menu control, program control, window display control, window viewing sequence control, word processing control, and video game function control.

30. The haptic feedback device of claim **[**25**]** *29*, wherein the surface indicia are chosen from the group consisting of lines, borders and textures.

* * * * *

ed by striking ''; but no patent shall be granted'' and all that follows through ''one year prior to such filing''. See 2011 Amendment note below.

AMENDMENTS

2011—Subsec. (a). Pub. L. 112–29, §3(g)(6), struck out ''; but no patent shall be granted on any application for patent for an invention which had been patented or described in a printed publication in any country more than one year before the date of the actual filing of the application in this country, or which had been in public use or on sale in this country more than one year prior to such filing'' before the period at the end.

Subsec. (e)(1). Pub. L. 112–29, §20(j), struck out ''of this title'' after ''363'' in two places and after ''111(b)'' in two places.

Pub. L. 112–29, §15(b), substituted ''section 112(a) (other than the requirement to disclose the best mode)'' for ''the first paragraph of section 112 of this title''.

Subsec. (e)(2). Pub. L. 112–29, §20(j), struck out ''of this title'' after ''111(b)'' and after ''41(a)(1)''.

Subsec. (g)(1). Pub. L. 112–29, §20(j), struck out ''of this title'' after ''104(b)(2)''.

EFFECTIVE DATE OF 2011 AMENDMENT

Amendment by section 3(g)(6) of Pub. L. 112–29 effective upon the expiration of the 18-month period beginning on Sept. 16, 2011, and applicable to certain applications for patent and any patents issuing thereon, see section 3(n) of Pub. L. 112–29, set out as an Effective Date of 2011 Amendment; Savings Provisions note under section 100 of this title.

Pub. L. 112–29, §15(c), Sept. 16, 2011, 125 Stat. 328, provided that: ''The amendments made by this section [amending this section and sections 120 and 282 of this title] shall take effect upon the date of the enactment of this Act [Sept. 16, 2011] and shall apply to proceedings commenced on or after that date.''

Amendment by section 20(j) of Pub. L. 112–29 effective upon the expiration of the 1-year period beginning on Sept. 16, 2011, and applicable to proceedings commenced on or after that effective date, see section 20(*l*) of Pub. L. 112–29, set out as a note under section 2 of this title.

§ 120. Benefit of earlier filing date in the United States

An application for patent for an invention disclosed in the manner provided by section 112(a) (other than the requirement to disclose the best mode) in an application previously filed in the United States, or as provided by section 363 of this title, which is filed by an inventor or inventors named in the previously filed application shall have the same effect, as to such invention, as though filed on the date of the prior application, if filed before the patenting or abandonment of or termination of proceedings on the first application or on an application similarly entitled to the benefit of the filing date of the first application and if it contains or is amended to contain a specific reference to the earlier filed application. No application shall be entitled to the benefit of an earlier filed application under this section unless an amendment containing the specific reference to the earlier filed application is submitted at such time during the pendency of the application as required by the Director. The Director may consider the failure to submit such an amendment within that time period as a waiver of any benefit under this section. The Director may establish procedures, including the payment of a surcharge, to accept an unintentionally delayed submission of an amendment under this section.

(As amended Pub. L. 112–29, §§3(f), 15(b), 20(j), Sept. 16, 2011, 125 Stat. 288, 328, 335.)

AMENDMENT OF SECTION

Pub. L. 112–29, §20(j), (l), Sept. 16, 2011, 125 Stat. 335, provided that, effective upon the expiration of the 1-year period beginning on Sept. 16, 2011, and applicable to proceedings commenced on or after that effective date, this section is amended by striking ''of this title'' each place that term appears. See 2011 Amendment note below.

Pub. L. 112–29, §3(f), (n), Sept. 16, 2011, 125 Stat. 288, 293, provided that, effective upon the expiration of the 18-month period beginning on Sept. 16, 2011, and applicable to certain applications for patent and any patents issuing thereon, this section is amended by striking ''which is filed by an inventor or inventors named'' and inserting ''which names an inventor or joint inventor''. See 2011 Amendment note below.

AMENDMENTS

2011—Pub. L. 112–29, §20(j), struck out ''of this title'' after ''363''.

Pub. L. 112–29, §15(b), substituted ''section 112(a) (other than the requirement to disclose the best mode)'' for ''the first paragraph of section 112 of this title''.

Pub. L. 112–29, §3(f), substituted ''which names an inventor or joint inventor'' for ''which is filed by an inventor or inventors named''.

EFFECTIVE DATE OF 2011 AMENDMENT

Amendment by section 3(f) of Pub. L. 112–29 effective upon the expiration of the 18-month period beginning on Sept. 16, 2011, and applicable to certain applications for patent and any patents issuing thereon, see section 3(n) of Pub. L. 112–29, set out as an Effective Date of 2011 Amendment; Savings Provisions note under section 100 of this title.

Amendment by section 15(b) of Pub. L. 112–29 effective on Sept. 16, 2011, and applicable to proceedings commenced on or after that date, see section 15(c) of Pub. L. 112–29, set out as a note under section 119 of this title.

Amendment by section 20(j) of Pub. L. 112–29 effective upon the expiration of the 1-year period beginning on Sept. 16, 2011, and applicable to proceedings commenced on or after that effective date, see section 20(*l*) of Pub. L. 112–29, set out as a note under section 2 of this title.

§ 121. Divisional applications

[See main edition for text]

(As amended Pub. L. 112–29, §§4(a)(2), 20(j), Sept. 16, 2011, 125 Stat. 295, 335.)

AMENDMENT OF SECTION

Pub. L. 112–29, §20(j), (l), Sept. 16, 2011, 125 Stat. 335, provided that, effective upon the expiration of the 1-year period beginning on Sept. 16, 2011, and applicable to proceedings commenced on or after that effective date, this section is amended by striking ''of this title'' each place that term appears. See 2011 Amendment note below.

Pub. L. 112–29, §4(a)(2), (e), Sept. 16, 2011, 125 Stat. 295, 297, provided that, effective upon the expiration of the 1-year period beginning on Sept. 16, 2011, and applicable to any patent application that is filed on or after that effective date, this section is amended by striking ''If a divisional application'' and all that follows

Treaty Request Form must be accompanied by a clear indication that treatment of the application as an application under 35 U.S.C. 111 is desired.

[65 FR 54668, Sept. 8, 2000, as amended at 65 FR 57054, Sept. 20, 2000; 69 FR 56540, Sept. 21, 2004; 70 FR 54266, Sept. 14, 2005;; 72 FR 46837, Aug. 21, 2007; 74 FR 52689, Oct. 14, 2009; 77 FR 48820, Aug. 14, 2012; 78 FR 11055, Feb. 14, 2013; 78 FR 62402, Oct. 21, 2013]

§ 1.77 Arrangement of application elements.

(a) The elements of the application, if applicable, should appear in the following order:

(1) Utility application transmittal form.

(2) Fee transmittal form.

(3) Application data sheet (see § 1.76).

(4) Specification.

(5) Drawings.

(6) The inventor's oath or declaration.

(b) The specification should include the following sections in order:

(1) Title of the invention, which may be accompanied by an introductory portion stating the name, citizenship, and residence of the applicant (unless included in the application data sheet).

(2) Cross-reference to related applications.

(3) Statement regarding federally sponsored research or development.

(4) The names of the parties to a joint research agreement.

(5) Reference to a "Sequence Listing," a table, or a computer program listing appendix submitted on a compact disc and an incorporation-by-reference of the material on the compact disc (see § 1.52(e)(5)). The total number of compact discs including duplicates and the files on each compact disc shall be specified.

(6) Statement regarding prior disclosures by the inventor or a joint inventor.

(7) Background of the invention.

(8) Brief summary of the invention.

(9) Brief description of the several views of the drawing.

(10) Detailed description of the invention.

(11) A claim or claims.

(12) Abstract of the disclosure.

(13) "Sequence Listing," if on paper (see §§ 1.821 through 1.825).

(c) The text of the specification sections defined in paragraphs (b)(1) through (b)(12) of this section, if applicable, should be preceded by a section heading in uppercase and without underlining or bold type.

[65 FR 54668, Sept. 8, 2000, as amended at 70 FR 1823, Jan. 11, 2005; 77 FR 48820, Aug. 14, 2012; 78 FR 11055, Feb. 14, 2013]

§ 1.78 Claiming benefit of earlier filing date and cross-references to other applications.

(a) *Claims under 35 U.S.C. 119(e) for the benefit of a prior-filed provisional application.* An applicant in a nonprovisional application, other than for a design patent, or an international application designating the United States of America may claim the benefit of one or more prior-filed provisional applications under the conditions set forth in 35 U.S.C. 119(e) and this section.

(1) Except as provided in paragraph (b) of this section, the nonprovisional application or international application designating the United States of America must be filed not later than twelve months after the date on which the provisional application was filed, or be entitled to claim the benefit under 35 U.S.C. 120, 121, or 365(c) of an application that was filed not later than twelve months after the date on which the provisional application was filed. This twelve-month period is subject to 35 U.S.C. 21(b) (and § 1.7(a)) and PCT Rule 80.5.

(2) Each prior-filed provisional application must name the inventor or a joint inventor named in the later-filed application as the inventor or a joint inventor. In addition, each prior-filed provisional application must be entitled to a filing date as set forth in § 1.53(c), and the basic filing fee set forth in § 1.16(d) must have been paid for such provisional application within the time period set forth in § 1.53(g).

(3) Any nonprovisional application or international application designating the United States of America that claims the benefit of one or more prior-filed provisional applications must contain, or be amended to contain, a reference to each such prior-filed provisional application, identifying it by the

provisional application number (consisting of series code and serial number). If the later-filed application is a nonprovisional application, the reference required by this paragraph must be included in an application data sheet (§ 1.76(b)(5)).

(4) The reference required by paragraph (a)(3) of this section must be submitted during the pendency of the later-filed application. If the later-filed application is an application filed under 35 U.S.C. 111(a), this reference must also be submitted within the later of four months from the actual filing date of the later-filed application or sixteen months from the filing date of the prior-filed provisional application. If the later-filed application is a national stage application under 35 U.S.C. 371, this reference must also be submitted within the later of four months from the date on which the national stage commenced under 35 U.S.C. 371(b) or (f), four months from the date of the initial submission under 35 U.S.C. 371 to enter the national stage, or sixteen months from the filing date of the prior-filed provisional application. Except as provided in paragraph (c) of this section, failure to timely submit the reference is considered a waiver of any benefit under 35 U.S.C. 119(e) of the prior-filed provisional application.

(5) If the prior-filed provisional application was filed in a language other than English and both an English-language translation of the prior-filed provisional application and a statement that the translation is accurate were not previously filed in the prior-filed provisional application, the applicant will be notified and given a period of time within which to file, in the prior-filed provisional application, the translation and the statement. If the notice is mailed in a pending nonprovisional application, a timely reply to such a notice must include the filing in the nonprovisional application of either a confirmation that the translation and statement were filed in the provisional application, or an application data sheet eliminating the reference under paragraph (a)(3) of this section to the prior-filed provisional application, or the nonprovisional application will be abandoned. The translation and statement may be filed in the provisional application, even if the provisional application has become abandoned.

(6) If a nonprovisional application filed on or after March 16, 2013, claims the benefit of the filing date of a provisional application filed prior to March 16, 2013, and also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013, the applicant must provide a statement to that effect within the later of four months from the actual filing date of the nonprovisional application, four months from the date of entry into the national stage as set forth in § 1.491 in an international application, sixteen months from the filing date of the prior-filed provisional application, or the date that a first claim to a claimed invention that has an effective filing date on or after March 16, 2013, is presented in the nonprovisional application. An applicant is not required to provide such a statement if the applicant reasonably believes on the basis of information already known to the individuals designated in § 1.56(c) that the nonprovisional application does not, and did not at any time, contain a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

(b) *Delayed filing of the nonprovisional application or international application designating the United States of America.* If the nonprovisional application or international application designating the United States of America has a filing date which is after the expiration of the twelve-month period set forth in paragraph (a)(1) of this section but within two months from the expiration of the period set forth in paragraph (a)(1) of this section, the benefit of the provisional application may be restored under PCT Rule 26*bis*.3 for an international application, or upon petition pursuant to this paragraph, if the delay in filing the nonprovisional application or international application designating the United States of America within the period set forth in paragraph (a)(1) of this section was unintentional.

(1) A petition to restore the benefit of the provisional application under this paragraph filed in the nonprovisional

application or international application designating the United States of America must include:

(i) The reference required by 35 U.S.C. 119(e) and paragraph (a)(3) of this section to the prior-filed provisional application, unless previously submitted;

(ii) The petition fee as set forth in §1.17(m); and

(iii) A statement that the delay in filing the nonprovisional application or international application designating the United States of America within the twelve-month period set forth in paragraph (a)(1) of this section was unintentional. The Director may require additional information where there is a question whether the delay was unintentional.

(2) The restoration of the right of priority under PCT Rule 26*bis*.3 to a provisional application does not affect the requirement to include the reference required by paragraph (a)(3) of this section to the provisional application in a national stage application under 35 U.S.C. 371 within the time period provided by paragraph (a)(4) of this section to avoid the benefit claim being considered waived.

(c) *Delayed claims under 35 U.S.C. 119(e) for the benefit of a prior-filed provisional application.* If the reference required by 35 U.S.C. 119(e) and paragraph (a)(3) of this section is presented in an application after the time period provided by paragraph (a)(4) of this section, the claim under 35 U.S.C. 119(e) for the benefit of a prior-filed provisional application may be accepted if the reference identifying the prior-filed application by provisional application number was unintentionally delayed. A petition to accept an unintentionally delayed claim under 35 U.S.C. 119(e) for the benefit of a prior-filed provisional application must be accompanied by:

(1) The reference required by 35 U.S.C. 119(e) and paragraph (a)(3) of this section to the prior-filed provisional application, unless previously submitted;

(2) The petition fee as set forth in §1.17(m); and

(3) A statement that the entire delay between the date the benefit claim was due under paragraph (a)(4) of this section and the date the benefit claim was filed was unintentional. The Director may require additional information where there is a question whether the delay was unintentional.

(d) *Claims under 35 U.S.C. 120, 121, or 365(c) for the benefit of a prior-filed nonprovisional or international application.* An applicant in a nonprovisional application (including an international application entering the national stage under 35 U.S.C. 371) or an international application designating the United States of America may claim the benefit of one or more prior-filed copending nonprovisional applications or international applications designating the United States of America under the conditions set forth in 35 U.S.C. 120, 121, or 365(c) and this section.

(1) Each prior-filed application must name the inventor or a joint inventor named in the later-filed application as the inventor or a joint inventor. In addition, each prior-filed application must either be:

(i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or

(ii) A nonprovisional application under 35 U.S.C. 111(a) that is entitled to a filing date as set forth in §1.53(b) or §1.53(d) for which the basic filing fee set forth in §1.16 has been paid within the pendency of the application.

(2) Except for a continued prosecution application filed under §1.53(d), any nonprovisional application, or international application designating the United States of America, that claims the benefit of one or more prior-filed nonprovisional applications or international applications designating the United States of America must contain or be amended to contain a reference to each such prior-filed application, identifying it by application number (consisting of the series code and serial number) or international application number and international filing date. If the later-filed application is a nonprovisional application, the reference required by this paragraph must be included in an application data sheet (§1.76(b)(5)). The reference also must identify the relationship of the applications, namely, whether the later-filed application is a continuation, divisional, or continuation-in-

part of the prior-filed nonprovisional application or international application.

(3) The reference required by 35 U.S.C. 120 and paragraph (d)(2) of this section must be submitted during the pendency of the later-filed application. If the later-filed application is an application filed under 35 U.S.C. 111(a), this reference must also be submitted within the later of four months from the actual filing date of the later-filed application or sixteen months from the filing date of the prior-filed application. If the later-filed application is a nonprovisional application entering the national stage from an international application under 35 U.S.C. 371, this reference must also be submitted within the later of four months from the date on which the national stage commenced under 35 U.S.C. 371(b) or (f) in the later-filed international application, four months from the date of the initial submission under 35 U.S.C. 371 to enter the national stage, or sixteen months from the filing date of the prior-filed application. Except as provided in paragraph (e) of this section, failure to timely submit the reference required by 35 U.S.C. 120 and paragraph (d)(2) of this section is considered a waiver of any benefit under 35 U.S.C. 120, 121, or 365(c) to the prior-filed application. The time periods in this paragraph do not apply in a design application.

(4) The request for a continued prosecution application under §1.53(d) is the specific reference required by 35 U.S.C. 120 to the prior-filed application. The identification of an application by application number under this section is the identification of every application assigned that application number necessary for a specific reference required by 35 U.S.C. 120 to every such application assigned that application number.

(5) Cross-references to other related applications may be made when appropriate (see §1.14), but cross-references to applications for which a benefit is not claimed under title 35, United States Code, must not be included in an application data sheet (§1.76(b)(5)).

(6) If a nonprovisional application filed on or after March 16, 2013, claims the benefit of the filing date of a nonprovisional application or an international application designating the United States of America filed prior to March 16, 2013, and also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013, the applicant must provide a statement to that effect within the later of four months from the actual filing date of the later-filed application, four months from the date of entry into the national stage as set forth in §1.491 in an international application, sixteen months from the filing date of the prior-filed application, or the date that a first claim to a claimed invention that has an effective filing date on or after March 16, 2013, is presented in the later-filed application. An applicant is not required to provide such a statement if either:

(i) The application claims the benefit of a nonprovisional application in which a statement under §1.55(j), paragraph (a)(6) of this section, or this paragraph that the application contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013 has been filed; or

(ii) The applicant reasonably believes on the basis of information already known to the individuals designated in §1.56(c) that the later filed application does not, and did not at any time, contain a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

(e) *Delayed claims under 35 U.S.C. 120, 121, or 365(c) for the benefit of a prior-filed nonprovisional application or international application.* If the reference required by 35 U.S.C. 120 and paragraph (d)(2) of this section is presented after the time period provided by paragraph (d)(3) of this section, the claim under 35 U.S.C. 120, 121, or 365(c) for the benefit of a prior-filed copending nonprovisional application or international application designating the United States of America may be accepted if the reference identifying the prior-filed application by application number or international application number and international filing date was unintentionally delayed. A petition to accept an unintentionally delayed claim under 35 U.S.C. 120, 121, or 365(c) for the benefit

of a prior-filed application must be accompanied by:

(1) The reference required by 35 U.S.C. 120 and paragraph (d)(2) of this section to the prior-filed application, unless previously submitted;

(2) The petition fee as set forth in § 1.17(m); and

(3) A statement that the entire delay between the date the benefit claim was due under paragraph (d)(3) of this section and the date the benefit claim was filed was unintentional. The Director may require additional information where there is a question whether the delay was unintentional.

(f) *Applications containing patentably indistinct claims.* Where two or more applications filed by the same applicant contain patentably indistinct claims, elimination of such claims from all but one application may be required in the absence of good and sufficient reason for their retention during pendency in more than one application.

(g) *Applications or patents under reexamination naming different inventors and containing patentably indistinct claims.* If an application or a patent under reexamination and at least one other application naming different inventors are owned by the same person and contain patentably indistinct claims, and there is no statement of record indicating that the claimed inventions were commonly owned or subject to an obligation of assignment to the same person on the effective filing date (as defined in § 1.109), or on the date of the invention, as applicable, of the later claimed invention, the Office may require the applicant to state whether the claimed inventions were commonly owned or subject to an obligation of assignment to the same person on such date. Even if the claimed inventions were commonly owned, or subject to an obligation of assignment to the same person on the effective filing date (as defined in § 1.109), or on the date of the invention, as applicable, of the later claimed invention, the patentably indistinct claims may be rejected under the doctrine of double patenting in view of such commonly owned or assigned applications or patents under reexamination.

(h) *Time periods not extendable.* The time periods set forth in this section are not extendable.

[78 FR 62402, Oct. 21, 2013]

§ 1.79 Reservation clauses not permitted.

A reservation for a future application of subject matter disclosed but not claimed in a pending application will not be permitted in the pending application, but an application disclosing unclaimed subject matter may contain a reference to a later filed application of the same applicant or owned by a common assignee disclosing and claiming that subject matter.

THE DRAWINGS

AUTHORITY: Secs. 1.81 to 1.88 also issued under 35 U.S.C. 113.

§ 1.81 Drawings required in patent application.

(a) The applicant for a patent is required to furnish a drawing of the invention where necessary for the understanding of the subject matter sought to be patented. Since corrections are the responsibility of the applicant, the original drawing(s) should be retained by the applicant for any necessary future correction.

(b) Drawings may include illustrations which facilitate an understanding of the invention (for example, flow sheets in cases of processes, and diagrammatic views).

(c) Whenever the nature of the subject matter sought to be patented admits of illustration by a drawing without its being necessary for the understanding of the subject matter and the applicant has not furnished such a drawing, the examiner will require its submission within a time period of not less than two months from the date of the sending of a notice thereof.

(d) Drawings submitted after the filing date of the application may not be used to overcome any insufficiency of the specification due to lack of an enabling disclosure or otherwise inadequate disclosure therein, or to supplement the original disclosure thereof for

conditions for entitlement to the benefit of the prior application have been met.

211.01 Requirements Related to the Prior-Filed Application [R-11.2013]

I. THE PRIOR-FILED APPLICATION MUST BE ENTITLED TO A FILING DATE

If the prior-filed application is a nonprovisional application filed under 35 U.S.C. 111(a), the application must be entitled to a filing date as set forth in 35 CFR 1.53(b) or (d), and the basic filing fee as set forth in 37 CFR 1.16 must have been paid within the pendency of the application. See 37 CFR 1.78. If the prior-filed application is an international application designating the United States of America, the prior-filed application must be entitled to a filing date in accordance with PCT Article 11. If the prior-filed application is a provisional application, the provisional application must be entitled to a filing date as set forth in 37 CFR 1.53(c) and the basic filing fee of the provisional application must have been paid within the time period set in 37 CFR 1.53(g) (the filing fee is paid within the time period set in 37 CFR 1.53(g) if an extension of time was filed to make a response to a notice to file missing parts requiring the filing fee timely).

Form paragraph 2.40 may be used to notify applicant that the application is not entitled to the benefit of the prior-filed application because the prior-filed application was not entitled to a filing date and/or did not include the basic filing fee.

¶ 2.40 Prior-Filed Application Not Entitled to a Filing Date or Basic Filing Fee Was Not Paid

This application claims the benefit of prior-filed application No. **[1]** under 120, 121, or 365(c) or under 35 U.S.C. 119(e). If the prior-filed application is an international application designating the United States of America, it must be entitled to a filing date in accordance with PCT Article 11. See 37 CFR 1.78. If the prior-filed application is a nonprovisional application, the prior-filed application must be entitled to a filing date as set forth in 37 CFR 1.53(b) or 1.53(d) and include the basic filing fee set forth in 37 CFR 1.16. See 37 CFR 1.78. If the prior-filed application is a provisional application, the prior-filed application must be entitled to a filing date as set forth in 37 CFR 1.53(c) and the basic filing fee must be paid within the time period set forth in 37 CFR 1.53(g). See 37 CFR 1.78.

This application is not entitled to the benefit of the prior-filed application because the prior-filed application **[2]**. Applicant is required to delete the reference to the prior-filed application.

Examiner Note:

1. Use this form paragraph to notify applicant that the application is not entitled to the benefit of the prior-filed application because the prior-filed application was not entitled to a filing date and/or did not include the basic filing fee.

2. In bracket 1, insert the application number of the prior-filed application.

3. In bracket 2, insert "was not entitled to a filing date"; "did not include the basic filing fee"; or "was not entitled to a filing date and did not include the basic filing fee".

II. SAME INVENTOR OR A COMMON JOINT INVENTOR

The statute requires that applications claiming benefit of the earlier filing date under 35 U.S.C. 119(e) or 120 name the inventor or at least one joint inventor named in the previously filed application or provisional application. Note that to be entitled to the benefit of any prior-filed application(s), in addition to naming the inventor or at least one common joint inventor, the invention claimed in the later-filed application must be supported in the manner provided by the 35 U.S.C. 112(a) or pre-AIA 35 U.S.C. 112, first paragraph, except for the best mode requirement. See MPEP § 211.04.

III. TRANSITION APPLICATION STATEMENT

If a nonprovisional application filed on or after March 16, 2013, claims the benefit of the filing date of a provisional or nonprovisional application filed prior to March 16, 2013, and also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013, the applicant must provide a statement to that effect within a specified time period. See 37 CFR 1.78(a)(6) and (c)(6) and MPEP § 210, subsection III.

IV. ADDITIONAL REQUIREMENTS

See MPEP § 211.01(a) for additional information and requirements specific to claiming the benefit of a provisional application.

See MPEP § 211.01(b) for additional information and requirements specific to claiming the benefit of an earlier-filed nonprovisional application.

211.01(a) Claiming the Benefit of a Provisional Application [R-11.2013]

When a later-filed application is claiming the benefit of a prior-filed provisional application under 35 U.S.C. 119(e), the nonprovisional application must be filed not later than 12 months after the date on which the provisional application was filed. If the day that is 12 months after the filing date of a provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, the nonprovisional application may be filed on the next succeeding business day. See 35 U.S.C. 21(b), 37 CFR 1.7(b), and MPEP § 201.04 and § 505.

In addition, each prior-filed provisional application must have the same inventor or at least one joint inventor in common with the later-filed application and must be entitled to a filing date as set forth in 37 CFR 1.53(c), and the basic filing fee set forth in 37 CFR 1.16(d) must have been paid for such provisional application within the time period set forth in 37 CFR 1.53(g). See MPEP § 211.01.

If benefit is being claimed to a provisional application which was filed in a language other than English, (A) an English language translation of the provisional application, and (B) a statement that the translation is accurate, are required to be filed in the provisional application. If the translation and statement were not filed in the provisional application, the applicant will be notified in the nonprovisional application and given a period of time within which to file the translation and statement in the provisional application, and a reply in the nonprovisional application confirming that the translation and statement were filed in the provisional application. In the alternative, for applications filed on or after September 16, 2012, applicant may reply to the notice by filing a corrected application data sheet in compliance with 37 CFR 1.76(c) deleting the reference to the prior-filed provisional application. For applications filed prior to September 16, 2012, applicant has the option of filing an amendment or a supplemental application data sheet in compliance with 37 CFR 1.76(c) (pre-AIA) deleting the benefit claim. In a pending nonprovisional application, failure to timely reply to such notice will result in the abandonment of the nonprovisional application. Form paragraph 2.38 may be used to notify applicant that an English translation of the non-English language provisional application is required.

¶ 2.38 Claiming Benefit to a Non-English Language Provisional Application

This application claims benefit to provisional application No. **[1]**, filed on **[2]**, in a language other than English. An English translation of the non-English language provisional application and a statement that the translation is accurate must be filed in provisional application No. **[3]**. See 37 CFR 1.78. The **[4]** required by 37 CFR 1.78 is missing. Accordingly, applicant must supply 1) the missing **[5]** in provisional application No. **[6]** and 2) in the present application, a confirmation that the translation and statement were filed in the provisional application. If 1) and 2) are not filed (or if the benefit claim is not withdrawn) prior to the expiration of the time period set in this Office action, the present application will be abandoned. See 37 CFR 1.78.

Examiner Note:

1. Use this form paragraph to notify applicant that an English translation of the non-English language provisional application and/or a statement that the translation is accurate is required. Do not use this form paragraph if a translation of the provisional application and a statement that the translation was accurate were filed in the nonprovisional application (the present application) before November 25, 2005.

2. In brackets 1 and 3, insert the application number of the non-English language provisional application.

3. In bracket 2, insert the filing date of the prior provisional application.

4. In brackets 4 and 5, insert --English translation and a statement that the translation is accurate-- or --statement that the translation is accurate--, where appropriate.

Applicant may claim the benefit of a provisional application by claiming the benefit of an intermediate copending nonprovisional application. The later-filed application must claim the benefit of the intermediate nonprovisional application under 35 U.S.C. 120, 121, or 365(c); the intermediate application must be filed not later than 12 months after the filing date of the provisional application (in which the basic filing fee was timely filed); and both the later-filed application and the intermediate application must

claim the benefit of the provisional application under 35 U.S.C. 119(e).

211.01(b) Claiming the Benefit of a Nonprovisional Application [R-11.2013]

I. COPENDENCY

When a later-filed application is claiming the benefit of a prior-filed nonprovisional application under 35 U.S.C. 120, 121, or 365(c), the later-filed application must be copending with the prior application or with an intermediate nonprovisional application similarly entitled to the benefit of the filing date of the prior application. Copendency is defined in the clause which requires that the later-filed application must be filed before: (A) the patenting of the prior application; (B) the abandonment of the prior application; or (C) the termination of proceedings in the prior application. If the prior application issues as a patent, it is sufficient for the later-filed application to be copending with it if the later-filed application is filed on the same date, or before the date that the patent issues on the prior application. Thus, the later-filed application may be filed under 37 CFR 1.53(b) while the prior application is still pending before the examiner, or is in issue, or even between the time the issue fee is paid and the patent issues. Patents usually will be published within four weeks of payment of the issue fee. Applicants are encouraged to file any continuing applications no later than the date the issue fee is paid, to avoid issuance of the prior application before the continuing application is filed.

If the prior application is abandoned, the later-filed application must be filed before the abandonment in order for it to be copending with the prior application. The term "abandoned," refers to abandonment for failure to prosecute (MPEP § 711.02), express abandonment (MPEP § 711.01), abandonment for failure to pay the issue fee (37 CFR 1.316), and abandonment for failure to notify the Office of a foreign filing after filing a nonpublication request under 35 U.S.C. 122(b)(2)(B)(iii) (MPEP § 1124). The expression "termination of proceedings" includes the situations when an application is abandoned or when a patent has been issued, and hence this expression is the broadest of the three copendency definitions.

After a decision by the Court of Appeals for the Federal Circuit in which the rejection of all claims is affirmed, the proceeding is terminated when the mandate is issued by the Court. There are several other situations in which proceedings are terminated as is explained in MPEP § 711.02(c).

When proceedings in an application are terminated, the application is treated in the same manner as an abandoned application, and the term "abandoned application" may be used broadly to include such applications.

The term "continuity" is used to express the relationship of copendency of the same subject matter in two different applications naming the same inventor or at least one joint inventor in common. The later-filed application may be referred to as a continuing application when the prior application is not a provisional application. Continuing applications include those applications which are called divisions, continuations, and continuations-in-part. The statute is so worded that the prior application may disclose more than the later-filed application, or the later-filed application maydisclose more than the prior application, and in either case the later-filed application is entitled to the benefit of the filing date of the prior application as to the common subject matter disclosed in compliance with 35 U.S.C. 112(a) or pre-AIA 35 U.S.C. 112, first paragraph, except for the best mode requirement.

A later-filed application which is not copending with the prior application (which includes those called "substitute" applications as set forth in MPEP § 201.02) is not entitled to the benefit of the filing date of the prior application. Therefore, prior art against the claims of the later-filed application is determined based on the filing date of the later-filed application. An applicant should not refer to such prior application(s) in an application data sheet (see 37 CFR 1.76) and is not required to refer to the prior application in the specification of the later-filed application, but is required to otherwise call the examiner's attention to the prior application if it or its contents or prosecution is material to patentability of the later-filed application as defined in 37 CFR 1.56(b).

Use form paragraphs 2.09 and 2.11 to indicate the benefit claim under 35 U.S.C. 120, 121, or 365(c) is improper because there is no copendency between the applications.

¶ 2.11 Application Must Be Copending With Parent

This application is claiming the benefit of prior-filed nonprovisional application No. **[1]** under 35 U.S.C. 120, 121, or 365(c). Copendency between the current application and the prior application is required. Since the applications are not copending, the benefit claim to the prior-filed nonprovisional application is improper. Applicant is required to delete the claim to the benefit of the prior-filed application, unless applicant can establish copendency between the applications.

Examiner Note:

1. This form paragraph must be preceded by heading form paragraph 2.09.

2. Do not use this form paragraph for benefit claims under 35 U.S.C. 119(e) to provisional applications.

3. In bracket 1, insert the application number of the prior-filed nonprovisional application.

Use form paragraphs 2.09 and 2.11.01 to indicate that the later-filed application must be filed not later than 12 months after the filing date of the provisional application for which a benefit is sought.

¶ 2.11.01 Application Must Be Filed Within 12 Months From the Provisional Application

This application is claiming the benefit of provisional application No. **[1]** under 35 U.S.C. 119(e). However, this application was not filed within twelve months from the filing date of the provisional application, and there is no indication of an intermediate nonprovisional application that is directly claiming the benefit of the provisional application and filed within 12 months of the filing date of the provisional application.

Note: If the day that is 12 months after the filing date of the provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, the nonprovisional application claiming the benefit of the provisional application may be filed on the next succeeding business day.

Applicant is required to delete the claim to the benefit of the prior-filed provisional application, unless applicant can establish that this application, or an intermediate nonprovisional application, was filed within 12 months of the filing date of the provisional application.

II. BENEFIT CLAIMS TO MULTIPLE PRIOR APPLICATIONS

Sometimes a pending application is one of a series of applications wherein the pending application is not copending with the first filed application but is copending with an intermediate application entitled to the benefit of the filing date of the first application. If applicant wishes that the pending application have the benefit of the filing date of the first filed application, applicant must, besides making reference to the intermediate application, also make reference to the first application. See *Sticker Indus. Supply Corp. v. Blaw-Knox Co.*, 405 F.2d 90, 160 USPQ 177 (7th Cir. 1968) and *Hovlid v. Asari*, 305 F. 2d 747, 134 USPQ 162 (9th Cir. 1962). The reference to the prior applications must identify all of the prior applications and indicate the relationship (i.e., continuation, divisional, or continuation-in-part) between each nonprovisional application in order to establish copendency throughout the entire chain of prior applications. Appropriate references must be made in each intermediate application in the chain of prior applications. See MPEP § 211.02 for guidance regarding properly referencing prior applications.

There is no limit to the number of prior applications through which a chain of copendency may be traced to obtain the benefit of the filing date of the earliest of a chain of prior copending applications. See *In re Henriksen*, 399 F2.d 253, 158 USPQ 224 (CCPA 1968). But see MPEP § 2190 (prosecution laches).

A nonprovisional application that directly claims the benefit of a provisional application under 35 U.S.C. 119(e) must be filed within 12 months from the filing date of the provisional application. Although an application that itself directly claims the benefit of a provisional application is not required to specify the relationship to the provisional application, if the instant nonprovisional application is not filed within the 12 month period, but claims the benefit of an intermediate nonprovisional application under 35 U.S.C. 120 that was filed within 12 months from the filing date of the provisional application and claimed the benefit of the provisional application, the intermediate application must be clearly identified as claiming the benefit of the provisional application so that the Office can determine whether the intermediate nonprovisional application was filed within 12 months of the provisional application and thus, whether the claim is proper. Where the benefit of more than one provisional application is being claimed, the intermediate nonprovisional application(s) claiming the benefit of each provisional application must be indicated. See MPEP § 211.02 for guidance regarding properly referencing prior applications.

If a benefit claim to a provisional application is submitted without an indication that an intermediate application directly claims the benefit of the provisional application and the instant nonprovisional application is not filed within the 12 month period or the relationship between each nonprovisional application is not indicated, the Office will not recognize such benefit claim and will not include the benefit claim on the filing receipt. Therefore, a petition under 37 CFR 1.78 and the surcharge set forth in 37 CFR 1.17(t) will be required if the intermediate application and the relationship of each nonprovisional application are not indicated within the period set forth in 37 CFR 1.78.

211.01(c) Claiming the Benefit of a International Application Designating the United States

Pursuant to 35 U.S.C. 365(c), a regular national application filed under 35 U.S.C. 111(a) and 37 CFR 1.53(b) may claim benefit of the filing date of an international application which designates the United States without completing the requirements for entering the national stage under 35 U.S.C. 371. See MPEP §§ 1895 and 1895.01. Thus, rather than submitting a national stage application under 35 U.S.C. 371, applicant may file a continuation, divisional, or continuation-in-part of an international (PCT) application under 35 U.S.C. 111(a). Such applications are often referred to as “bypass” applications. To claim the benefit of the filing date of an international application, the international application must designate the United States and be entitled to a filing date in accordance with PCT Article 11, and the later-filed application must be filed during the pendency (e.g., prior to the abandonment) of the international application.

The ability to take such action is based on provisions of the United States patent law. 35 U.S.C. 363 provides that “An international application designating the United States shall have the effect, from its international filing date under article 11 of the treaty, of a national application for patent regularly filed in the Patent and Trademark Office.” 35 U.S.C. 371(d) indicates that failure to timely comply with the requirements of 35 U.S.C. 371(c) “shall be regarded as abandonment by the parties thereof....” It is therefore clear that an international application which designates the United States has the effect of a pending U.S. application from the international application filing date until its abandonment as to the United States. The first sentence of 35 U.S.C. 365(c) specifically provides that “In accordance with the conditions and requirements of section 120 of this title,... a national application shall be entitled to the benefit of the filing date of a prior international application designating the United States.” The condition of 35 U.S.C. 120 relating to the time of filing requires the later application to be “filed before the patenting or abandonment of or termination of proceedings on the first application....”

211.02 Reference to Prior Application(s) [R-11.2013]

I. APPLICATION DATA SHEET

Both 35 U.S.C. 119(e) and 120 include the requirement that the later-filed application must contain a specific reference to the prior application.

For applications filed on or after September 16, 2012, the specific reference to the prior application must be included in an application data sheet (37 CFR 1.76). For applications filed prior to September 16, 2012, the specific reference to the prior application must be in an application data sheet (37 CFR 1.76(a)) and/or in the specification (preferably appearing as the first sentence(s) of the specification following the title). If applicant is claiming the benefit of multiple prior applications, and the reference to the prior applications is in the specification, the reference may be in a continuous string of multiple sentences at the beginning of the specification. The multiple sentences must begin as the first sentence after the title, and any additional sentence(s) including a benefit claim must follow the first sentence and not be separated from the first sentence by any other sentence not making a benefit claim. If the specific reference is only contained in the application data sheet, then the benefit claim information will be included on the front page of any patent or patent application publication, but will not be included in the first sentence(s) of the specification.

CERTIFICATE OF SERVICE

I hereby certify that I electronically filed the foregoing with the Clerk of the Court for the United States Court of Appeals for the Federal Circuit by using the appellate CM/ECF system on August 5, 2015.

I certify that all participants in the case are registered CM/ECF users and that service will be accomplished by the appellate CM/ECF system.

Dated: August 5, 2015 /s/ Joseph R. Palmore

CERTIFICATE OF COMPLIANCE WITH RULE 32(a)

This brief complies with the type-volume limitation of Rule 32(a) of the Federal Rules of Appellate Procedure because it contains 12,164 words.

Dated: August 5, 2015

/s/ Joseph R. Palmore